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A RATIONAL APPRENTICE SYSTEM.

NEW YORK CENTRAL LINES.

Part IV.

Abstract of the Proceedings of the First Conference of the Apprentice Instructors.

A conference of all of the apprentice instructors of the New York Central Lines was held at the Collinwood shops, September 18 and 19. Mr. C. W. Cross, superintendent of apprentices, presided while shop topics were under discussion and Mr. W. B. Russell, his assistant, while educational subjects were being considered. The drawing instructors present were, Messrs. A. L. Devine, West Albany; C. P. Wilkinson, Jackson; G. Kuch, Sr., Depew; R. M. Brown, Collinwood; Henry Gardner, McKees Rocks; F. Deyot, Jr., East Buffalo; A. W. Martin, Brightwood; C. A. Towsley, Elkhart and H. S. Rauch, Oswego. The shop instructors present were, Messrs. Frank Nelson, West Albany; C. T. Phelan, Jackson; P. P. Foller, Depew; Thomas Fleming, Collinwood; J. R. Radcliffe, McKees Rocks, and J. S. Lauby, Elkhart. Mr. F. W. Thomas, supervisor of apprentices on the Santa Fe; Mr. John Purcell, shop superintendent of the Santa Fe at Topeka; Mr. Martin Gower of the Canadian Pacific Railway, and Mr. R. V. Wright, editor of the AMERICAN ENGINEER AND RAILROAD JOURNAL, were present, as invited guests. Several of the mechanical officials at Collinwood dropped in at various times and took part in the proceedings.

The conference was a great success, although it had been arranged in only a few weeks' time. The papers presented were short and to the point, and the discussions were very practical, bringing out much important information as to the various methods which had been used and had given good results at the different schools. For this reason, and because of the importance of the apprentice question at this time, and the demand for concrete information concerning the working of successful systems, we feel justified in presenting a rather complete abstract of what took place at these meetings.

Mr. Cross' Opening Address.

In opening the conference Mr. Cross spoke in part as follows:

"The foundation principle of this apprentice system is the combination of the practical and educational training of apprentices, in a manner to provide for recruiting the service with young men who have been trained in the details of the work under actual shop conditions and in the atmosphere of the shop. The higher officers, subordinate officers, foremen and workmen, as well as the apprentices, are enthusiastic in their commendation and support of it. It means that the shops will be supplied with workmen who have been trained in the theory and practice of the business and their efficiency will be correspondingly increased."

"The subject of administration is of special importance at this time. The standing of the instructor in the organization, his relation to the apprentices, to the workmen in general, and to the foreman and other local officers, is important. If this relation is right and there is a thorough support and co-operation, the results cannot fail to be satisfactory. With regard to shop practice in instructing apprentices, any set rules for the purpose would soon become obsolete on account of the frequent changes, due to improvements. The better plan, therefore, seems to be to have the instructor one who is a part of the organization, in an official position, in addition to that of instructor, thus being in possession of all information covering changes and standards. This combination will enable him to impart to the apprentice instructions in line with late approved practice, in addition to the fundamental principles of the several mechanical trades.

"The best method of handling work to increase the efficiency of individuals and of machine tools should be made a subject of frequent consultation between the instructor and the foremen. This should be done in a manner to impress the foremen with the value of the services of the instructor, in helping him to increase the output and quality of the work of his department."

Mr. Russell's Remarks.

Mr. Russell spoke of the educational part of the work as being one of the most difficult problems along educational lines, because of the ungraded classes. He called attention to the far-reaching effects of the training now being given, and asked the instructors to take a broad view of the work and to keep in mind the final results to be obtained, especially when they were apt to be discouraged. He brought out the fact that no two boys were exactly alike, that each requires a different treatment and that it is often the off-hand word, or the problem, thought of at the moment, that may make the deepest impression. The fact that the greatest flexibility must always be maintained in the methods of teaching and in the subjects taught, was emphasized, as well as the importance of covering the ground thoroughly and not attempting to rush the work. Each drawing instructor should have an assistant, or understudy, who will be in position to assume his duties temporarily, in case of emergency, or permanently, if necessary.

Entrance Examinations.

SHOULD AN ADMISSION EXAMINATION IN ARITHMETIC BE GIVEN?

Mr. J. S. Lauby.—Yes! It is argued that anyone that can pass the examination is too wise to want to learn any of the trades that require hard, muscular labor, as for example, the boiler-makers' trade. Facts have shown, however, that if the boy can pass the examination, he is bright enough to grasp all the opportunities that are given him to acquire knowledge, and knows that general culture will be beneficial to him in any trade or profession that he may choose to follow. Boys who are entirely devoid of ambition do not often make desirable men, even though they may develop into men of great muscular ability and rugged constitution. A man that is only a machine is seldom automatic and requires a man to operate him.

Only recently we had an applicant for machinist apprentice who knew absolutely nothing about multiplication or division Had he been taken on as an apprentice he would have had only about one-half hour training in mathematics each morning that he attended classes, two days per week, or in other words about an hour each week. While in the shop he would have had approximately 50 hours per week at his trade. He would thus have been advanced so much more rapidly at his trade than in mathematics, that we could not possibly have had him ready at the expiration of his apprenticeship to solve the problems that come to the journeyman in calculating gears for screw cutting; finding unknown dimensions for given ones; and in making the ordinary calculations required. In addition he was detected copying from the work of another applicant who was being examined at the same time, showing a disposition to deceive. Would he not deceive his foreman later on in his work, if an opportunity presented itself?

Our examination is not a hard one and we have no fixed grade that must be attained to pass, but we determine by close observation the applicant's aptness and disposition. Sometimes an applicant will show by his work that he understands the methods that should be employed, but is hasty or careless and consequently inaccurate, or that his memory is at fault and only requires a little prompting to recall similar problems of his school days. The examination therefore gives us a knowledge of his weak points and when he comes under our instruction we know just where to strengthen him. He is advised at the beginning

of the examination that anything he does not understand relating to the meaning of the questions or problems will be fully explained, but that we are not permitted to suggest any answer or method of solution.

Discussion.—The fact developed that, while at all of the schools some form of so-called entrance examination is given, it is not in reality an examination in the ordinary sense of the word. In some cases it is quite informal. The boys are not required to attain any given grade, but the way in which they answer the questions gives the instructor a clue as to their knowledge of simple arithmetic. It was generally agreed that these examinations were much less important than sizing the boy up in an informal chat. A boy who applies for admission and has had very few opportunities will in many cases make better material eventually than one who has had greater opportunities but has not taken full advantage of them, although of course the latter boy would make a much better showing in a formal entrance examination. Certain apprentices, such as boiler maker and moulder, will not require as wide a knowledge of mathematics as those in some of the other trades.

In a certain large technical school an entering class numbered 450, but four years later there were less than 200 of them graduated. Most of those who fell out found they were not fitted for the profession for which they were studying. This shows how futile entrance examinations are for weeding out material which is not desirable. In closing the discussion of this question the following quotation was read from a paper presented before the American Society of Mechanical Engineers in 1899 by Mr. Milton P. Higgins. *"Instead of entrance examinations, a careful, quiet, honest investigation into the boy's life, as to habits of work and study, as to his personal habits of order, as to how he spends his evenings, Sundays and holidays, as to his love and care of tools for mechanical work, especially as to what he has actually constructed with tools before he was 14 years of age. Are not these things a truer indication of a boy's fitness for the life of a mechanic or engineer than the one single quality of being able to pass written entrance examinations?"*

What Kind of Boys Make the Best Mechanics?

The following question was asked by Mr. Gower and a vote of the instructors was taken. "In your opinion which boys make the best mechanics: a, those with no education; b, those with a public school education; c, those with a high school education; d, those with a technical school education?" It was the unanimous opinion that boys with a public school education would make the best mechanics. Those who have a high school or technical education, after they have received a thorough shop training, if they have the right kind of stuff in them, are equipped for more important positions.

Moral Training of Apprentices.

WHAT CAN THE INSTRUCTOR DO TO DEVELOP CHARACTER IN THE APPRENTICES?

Mr. H. S. Rauch.—The instructor should first see that his own character is above reproach, then get the confidence, and with it the esteem of the apprentices. He should find out how they spend their time outside of shop hours; if some are in the habit of keeping questionable company, a friendly confidential talk will many times work wonders. The services of the Railroad Y. M. C. A. can be enlisted to good advantage in helping to mold the character of our apprentices, as it always stands ready to give a room for meetings, lectures or discussions.

Apprentice clubs will go a long way toward keeping the apprentice well employed while out of the shop. A room should be provided for the apprentices, preferably at the Y. M. C. A., where they can drop in at any time and find good reading in the shape of mechanical journals and general literature. The railroad could lend its papers with the assurance that they would be taken care of and returned after a reasonable length of time.

Instructors should try to find all the good there is in an apprentice, and should appeal to that vein of good to correct any evil tendency that may exist. If they should get into bad company and into trouble, as sometimes happens, the instructor should use all his influence to help them out, and he will then have a lever to influence them for good. He should always show them that he has their future welfare at heart, and that he expects big things of them, and they will not often disappoint him.

Discussion.—It is, of course, first necessary to gain the boy's confidence, and then to try and correct any evil influences by bringing better ones to bear upon him and talking things over with him in a quiet way. The question of cigarette smoking was

NEW YORK CENTRAL LINES APPRENTICE INSTRUCTORS' CONFERENCE.

Top row, reading from the left: J. S. Lauby; Frank Nelson; A. L. Devine; Henry Gardner; F. Deyot, Jr.; R. M. Brown and C. P. Wilkinson. Intermediate row, reading from the left: C. A. Towsley; C. T. Phalen; J. R. Radcliffe; Thomas Fleming; W. B. Russell; H. S. Rauch and Martin Gower, C. P. R. Lower row, reading from the left: G. Kuch, Sr.; A. W. Martin; P. P. Foller and C. W. Cross.

discussed. At some of the schools boys who smoke cigarettes are discharged if they will not give it up, and the general opinion seemed to be that boys who have this habit should not be enrolled as apprentices.

The moral development of the boys is exceedingly important; it will make no difference in the immediate shop output, but ten years from now it will bring results in plenty. The development of loyalty to themselves, their employers and their country—this is worth more in dollars and cents than most of us dream. What can be better for everyone concerned than an earnest, loyal corp of employees, sober and industrious, wide awake and ambitious.

THE IDEAL RELATIONS BETWEEN APPRENTICE AND INSTRUCTOR.

Mr. H. S. Rauch.—The relations which should exist between the instructor and the apprentice are those which exist between close friends. The boys should be given to understand that they are welcome to come to the instructor at any time, either in the shop or outside, for all kinds of advice, not only as to their work but on any subject which may be uppermost in their minds.

Always make the apprentice feel welcome by giving him your attention and a pleasant word; get his confidence by showing him that you have confidence in him; be interested in those things he is interested in, both in the shop work or in the pursuit of pleasure. If a boy is interested in baseball, talk baseball to him; if boating, fishing or horses, talk these with him at the proper time, and you will soon have his entire confidence. Under all circumstances show him that you are his friend, champion his cause, if it be a worthy one; if not, show him where he is wrong. Never let an opportunity go by to help him, to show him that his interests are your interests; never fail to show your approval of his laudable achievements; give praise where praise is due, and if it becomes necessary to reprove him, do it privately and in such a manner that it will leave no sting. Never promise things you are not sure you can do; treat the apprentice as though he was a man; boys like to be taken for men. Consult with the boys on any matter in hand; get their opinion as though they were men; in many cases it will be of more value than you think, and even though it is valueless, the next time it will be better. Thus show them that you have confidence in their ability and they will strive not to disappoint you.

A foreman wanted sketches and a tracing of a conductor's box; he was in a hurry; the shop draftsman was crowded with work and could not make them, but finally induced the foreman to let a second-year carpenter apprentice make a try at the job; he thought he couldn't do it; his instructor told him he knew he could; he did, and made a good job of it, and the result was 100 per cent. increase in the interest of the apprentice. Instill in the minds of the apprentices that we are all working for a common goal,—that of advancing our positions in life,—and that everything learned makes us just that much more valuable to the company by which we are employed.

Discussion.—This paper also brought out the question of improving the morals of the boys, and it was quite generally admitted that more could be accomplished toward correcting bad habits by having a quiet talk with them, individually, than in any other way. Concerning the matter of swearing, Mr. Purcell stated that when he found a boy using such language he usually asked him how he would like to see it in print with his name signed. This usually made such an impression upon the boy that he was more careful in the future.

Educational Work.

HOW TO INTEREST BOILER SHOP APPRENTICES.

Mr. C. P. Wilkinson.—It is well known that the boilermaker's trade is one that does not appeal to the type of boy who cares to study and read, and consequently it is necessary to take those who, as a rule, care but little for books, but who, nevertheless "make good" in the shops. To interest this class, school work should be confined almost exclusively to boiler shop practice and should combine the drawing and arithmetic almost from the start. It is all right to give these boys the first twenty or thirty sheets in mechanical drawing, which are used by the other trades, but after that they should be given simple plate work in drawing, and such problem work as figuring areas and weights. Instead of car and locomotive details in drawing, familiar objects in the boiler shop should be considered, such as flange blocks, various small tools, boiler braces, stays and clamps, and later, if they are able to go ahead, the more complicated work of laying out.

As soon as a boy shows that he is worthy of advancement and takes an interest in his work, have him, instead of putting in his whole time in the drawing class, go to the shop and assist in laying out work or doing it himself. This will encourage him in his studies. In order to hold the interest of boiler shop apprentices, the work cannot be too simple at the start. If it is too hard they easily become disheartened.

Discussion.—At the Jackson shops the boys, after they have done a certain amount of drawing work, are occasionally turned over to the boiler shop foreman and do actual laying out under the direction of the layer out. While laying out work to full size on wrapping paper in the drawing room is of value, it does not appeal to the boys the way the actual work does, and this is especially true if, after they have laid a sheet out, they are required to follow it up and finish it. Where laying out work of this kind is done the boys work continuously at the job until it has been completed and the time is credited to their school work.

The suggestion was made that ¼ size wooden models could be made of the different parts of the boiler; the apprentice could then lay the different sheets out on paper, and after cutting them to shape, place them about the model to see that they fitted properly.

The general opinion seemed to be that it would be advisable to start the boys upon boiler shop subjects, in connection with their drawing course, as soon as possible, rather than to have them keep on exercises which had been arranged for the machine shop apprentices.

TYPE OF PROBLEMS THAT APPEAL TO THE BOYS.

Mr. C. P. Wilkinson.—With the many different dispositions and influences to contend with, it is out of the question to have any fixed rule to fit all cases, yet it would seem that much can be accomplished if we fully realize the things a boy should know and teach him these in as simple a way as possible, without attempting to drive him.

Illustrations should be used in connection with the problems, as they give the boys a better understanding of the subject. Use sketches or diagrams with every problem possible and boil all subjects down to the limit of simplicity and directness. The examples should not necessarily be confined to railroad work, but should include anything about the home or outside that is familiar; the result will indirectly benefit the railroad. Problems in the nature of the following should be used: Find the number of cubic feet in a coal bin shown in a sketch and the tons of coal it will hold. Find the gallons, or barrels, contained in a cistern shown in a picture. Find the cost of sidewalk per square foot. Find the cost of carpet per room plan. A few problems of each kind would be beneficial to the majority of apprentices. From the shop, problems in springs, when a sketch is given to show the method of calculating; or to find the weight and the square inches of wearing surface of an axle shown on a sketch. Even where it is impossible to make any headway with a boy in the drawing room, instruction along these lines has produced good results.

The same course should be followed with all apprentices, as has been outlined for the boiler shop boys; that is, when they have drawings to make where laying out is involved, they should spend a part of the school time on this work in the shop.

Discussion.—The instructors strongly advocated the use of as many sketches or illustrations, as possible, in connection with the problem sheets. It not only makes the meaning of the problems plainer, but serves to increase the interest which the boys take in this work.

PROBLEMS, SHOULD THEY BE COMPULSORY?

The topic was opened by Mr. Henry Gardner, who presented a plain statement of the difficulties encountered in keeping the

boys interested in this work. Problem work should be made compulsory. When a boy enrolls as an apprentice he is given to understand that there is a certain amount of study which must be done outside of working hours. The company pays him for the two hours that he attends school two mornings in the week and it is only fair that he should be willing to devote some of his own time to educational work. The surroundings of some of the boys at their boarding places is not very favorable for study, but a difficulty of this kind can usually be overcome by a boy with any ambition. Many of the boys spend their noon hour on problems.

A certain part of the school time may be advantageously given over to this work, but this should be more along the line of blackboard exercises for the purpose of reviewing the work, and seeing that the boys understand the principles which they have learned. The ambitious boy does not ordinarily need any coaxing or incentive, but the greater number of the boys require careful looking after as regards the problem work. The conference fixed upon a minimum number of problems which must be done correctly by each boy every month; this minimum was made low enough so that there can be no reasonable excuse for any boy not accomplishing it, and if he cannot do so he is hardly a fit subject for apprentice training. While this minimum was established, most of the boys are capable of doing much more; the actual number required of each one depends on his ability and is to be determined by the instructor. It is possible to interest some of the slower boys by substituting problems which will attract and interest them more than the ones in the regular course; this is left to the judgment of the instructor. The question would be a considerably easier one to solve if the apprentice school could be graded, but it is impossible to do this.

How to Secure the Best Results in Blackboard Problem Work.

Mr. A. L. Devine.—The necessity for introducing blackboard work in connection with the problems was seen soon after the inauguration of the apprentice school at the West Albany shops. The reasons were as follows:

1. The fact that no examination in arithmetic was given had resulted in the admission of a number of boys deficient in addition and subtraction. Several instances had been found where a number of apprentices lived in the same house (six in one case) and where one of the number had worked the problems for the others. In many cases friends or relatives were working an undue proportion of the home work, and the boy himself but a small part of it. The blackboard work enabled the instructor to locate these conditions and find whether the boys really understood the work they were doing.

2. The gain derived by the apprentice in increased confidence by working problems before the others.

3. The advantage of this form of work as a review and as an opportunity for the instructor to correct faults and get familiar with the boys' real ability. This would also offer an opportunity to relieve the instructor's work by the use of advanced boys to check the slower ones.

The following methods were tried: The entire class was sent to the board, and simple arithmetic problems were given out verbally, the same problems to the entire class or to different groups. This did not work well because of the tendency to copy, and the time required to give out the problems and to check results. The boys were next given problems from the PA series, pasted on card board of convenient size. This was open to the same objections as the previous experiment. Finally each apprentice was given five examples in simple addition without any wording. They were on a blue print pasted on a small card. The first example was quite simple, and the others harder so that the five would require about an hour for solution by the average boy. There were five different sets of examples, but they looked so much alike that the difference was hardly noticeable. The instructor had the answers in advance and arranged the assignment so that adjacent boys did not have the same problems. This scheme works well, causes no confusion and requires but little of the instructor's time.

The following recommendations are based on our experience at the West Albany shops.

1. That an entrance examination in arithmetic be given outside of class hours, to consist of one problem each in addition, subtraction, multiplication, division, fractions and decimals.

2. That sets of problems in groups of five be prepared for use on the blackboard, similar to those described, covering simple addition, subtraction, multiplication, division, fractions, decimals, areas, squares and cubes, and other subjects.

3. That if possible the entire class be sent to the board at the same time, at least once in two weeks, and that each boy be required to do the assigned problems correctly before he is allowed to resume his drawing.

The Type of Drawing Required for Car Shop Apprentices.

Mr. F. Deyot, Jr.—Experience has shown that distinctively locomotive drawing is not suitable for car shop apprentices and cannot be used to advantage. The first part of a drawing course for car apprentices will of necessity be somewhat similar to that for those in the locomotive department; the subjects, however, should be, as far as possible, parts of cars and familiar machines. Simpler details of the various types of freight cars can then be introduced. Starting first with the trucks, the details can be drawn and then an assembled drawing of the truck may be made. The draft gear can then be considered in the same way. Then should follow the floor plans, roof and other parts of freight cars, thus giving the apprentices who do not work directly on cars, a thorough understanding of the construction and the location of the different parts of wooden freight equipment, at the same time making them familiar with the names of the parts and the material used. Passenger car drawing should follow, and after this the engineering equipment, such as track flangers, road bed spreaders, derricks and snow plows, a class of work involving more or less knowledge of machinery.

Grading Classes.

It is practically impossible to grade them without interfering with the shop work, although it would be desirable to do so, if possible. There are, however, some advantages in being able to divide the poorer boys among the different classes, as it enables the instructor to give them more individual attention. Even where it is possible to start with the classes graded, experience has shown that the boys pull apart quite rapidly.

Separate Marks in Drawing and Problems.

Up to this time it has been the practice, at least in regard to the reports which were forwarded to headquarters, to use one mark only for the educational work. It was unanimously decided that better results could be accomplished by having two separate marks.

Should the Class Room and Shop Drafting Room Be Separated?

It was the general opinion that the school room should be separated from the shop draftsman's room, but adjacent to it, so that the drawing room records would be convenient for reference.

Drafting Room Experience.

The question came up as to whether the experience in the drafting room, which is given in some of the shops in connection with the apprentice training, was detrimental, in that it unsettled the boys for going back to the actual shop work. It was the opinion that this might be so with certain kinds of boys who had a leaning toward drafting room work but that the boy who remained in the shop would, in the long run, be better off. It was shown that only a small percentage of the boys are given the 60 or 90 day drafting room assignment and that the majority of these, if left to choose, prefer to return to the shop.

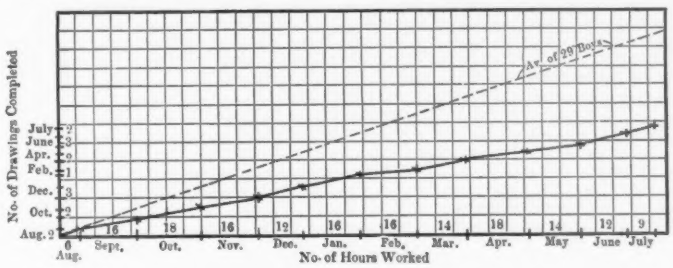
Time of Holding Classes.

There seems to be no question but that the first two hours in the morning are the most suitable for this work; other times have been tried at some of the shops, previous to the establish-

ment of the present system, but were not found to be as satisfactory. The boys' minds are clearer and they can work to better advantage in the morning. At other times in the day there is more or less running work to be finished from which the boys can often not be spared without seriously interfering with the output. From the standpoint of shop output the time of meeting would make little difference, except in cases of this kind.

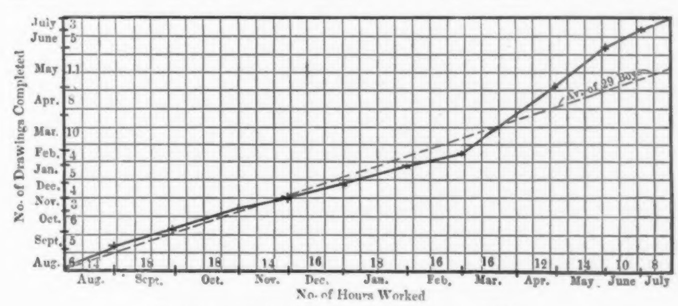
EFFICIENCY DIAGRAMS.

Mr. Henry Gardner.—In the accompanying diagrams, an attempt has been made to show graphically the work performed in mechanical drawing for the year ending August 1, 1907. The horizontal spaces each represent one hour of actual time worked, each vertical space a standard drawing plate completed. The total hours worked and the corresponding total plates completed each month are shown. The number of hours actually worked per plate was not used, as such a degree of accuracy would not be of sufficient importance to justify the amount of time and labor involved. By plotting this data we get points at the end of each



Total hours worked	167
Total drawings completed	29
No. drawings per month	2.6
No. hours per drawing	5.7
Mark for speed	35%
Mark for quality	55%
Efficiency	50%

MECHANICAL DRAWING EFFICIENCY DIAGRAM FOR A POOR APPRENTICE.



Total hours worked.............	174
Total drawings completed	70
No. drawings per month	5.8
No. hours per drawing	2.5
Mark for speed	80%
Mark for quality	85%
Efficiency	83%

THIS BOY "WAKED UP" ABOUT MARCH FIRST.

month, which, when connected form the irregular line or "curve" of progress.

In order to form a satisfactory basis of comparison, averages of twenty-nine representative boys were taken which, when plotted, produced the straight broken line as shown on the diagrams. This line is only approximately correct; the actual line would be a curve obtained by plotting the mean of the twenty-nine curves superimposed. The straight line is valuable for comparison since each curve is referred to it, thus making all deductions relative and proportionate. The boys' progress from month to month is clearly shown.

No account was taken of the fact that some plates are more difficult than others and require more time and thought; such a degree of accuracy was not of sufficient value to warrant the additional labor. The plates do not vary in extreme cases more than two hours in the time required to complete them, and a large number are practically of equal weight in this respect.

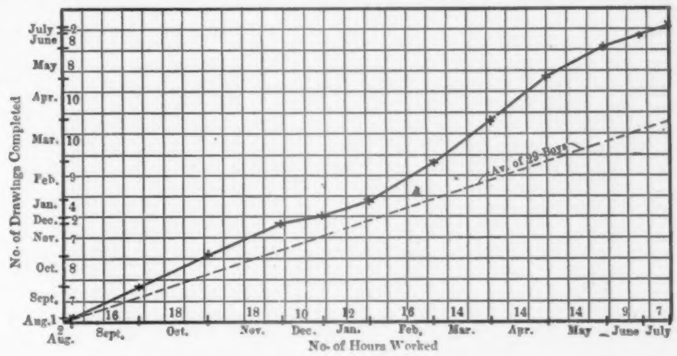
A similar diagram for the work in arithmetic could be plotted and would be equally useful and instructive. It would be more difficult, however, to determine the actual time worked since the arithmetic is done outside of the class room.

The effect of these diagrams has been to stimulate the work to a considerable extent, such that care must be exercised to keep the quality up and to discourage racing for a record. The boys are greatly interested in their "curves" and are trying to raise them higher each month.

Discussion.—It was suggested that good results could be obtained by encouraging the boys to keep their own curves or by making it part of the class work. They would thus become familiar with plotting graphical records, which are coming into more and more general use on our railroads. As regards a curve for problems, the time actually required to work them would be of less importance than the number of problems turned in, correctly worked out, at regular intervals of time.

DISCIPLINE IN THE SCHOOL ROOM.

The drawing instructor's authority, as to discipline in the school, should be absolute and thoroughly understood by all concerned. There are instances where much may be accomplished in handling a boy, who is difficult to bring into line, by having a private understanding with the shop superintendent, or master



Total hours worked	150
Total drawings completed	71
No. drawings per month	5.9
No. hours per drawing	2.1
Mark for speed	95%
Mark for quality	90%
Efficiency	93%

EFFICIENCY DIAGRAM FOR ONE OF THE BEST BOYS.

mechanic, to call the boy in and give him a talking to, with the full understanding that the instructor is in complete charge of the boy. When it comes to a show-down the recommendations of the instructor should be the ruling decision.

The instructor, in order to maintain the dignity of his position, should not send the boys to the superintendent of shops for discipline, unless he is prepared to recommend them for dismissal. In speaking of this matter Mr. Purcell of the Santa Fe stated that in starting their new apprentice system he had made the ruling that the instructors were supreme in the matter of discipline in the school room, and that if the instructor sent a boy to the office for his time, no matter how slight the offense, he could not get back into the service except through the instructor. While it is possible for the instructor to handle most cases of insubordination by persuasive methods, there are times when harsh methods must be taken, and promptly.

SHOULD ADVANCED BOYS GIVE TALKS ON SIMPLE SUBJECTS?

The general opinion was that it would be a good scheme to have some of the more advanced students present short informal talks on simple topics. This would not only be of great assisttance to them, but would add to the interest to the class work.

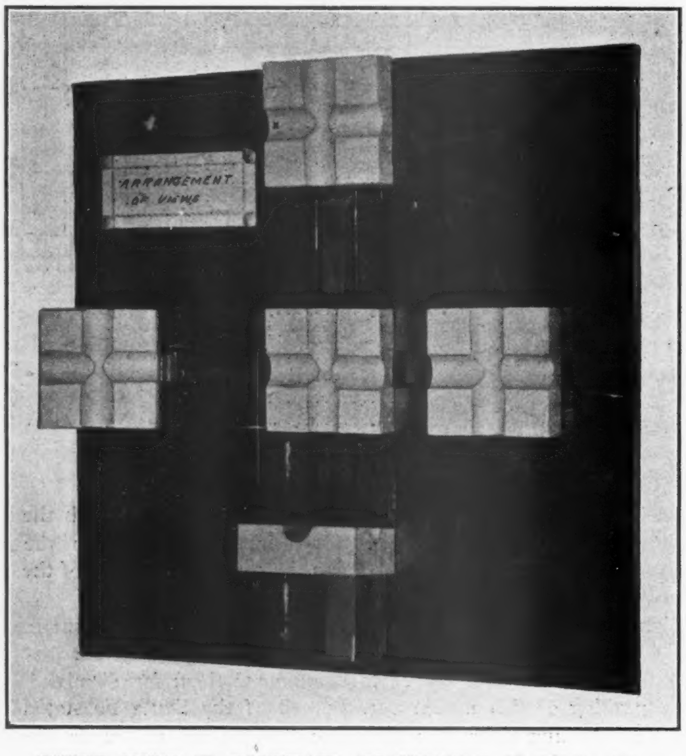
IS THE PRACTICE OF USING ADVANCED STUDENTS TO HELP SLOW ONES ADVISABLE?

Mr. J. S. Lauby.—Yes! We practice it at Elkhart and find it gives the assistant an excellent opportunity for review, and at the same time creates in the one assisted a desire to attain such an efficiency that he too can occupy the position, or else creates

a sense of shame, that his fellow student is better qualified than he is. Whichever view he takes, if he has any spirit at all, his energies are aroused and it is bound to work to his advantage. We do not attempt to use a pupil for an assistant in drawing unless he has had, or is taking, his three months' experience in the drafting room.

We are also careful to see that the assistant does not perform the work himself. This is an important point in all of our work. There are many cases where an apprentice is only too willing to let the instructor do the work while he stands by and looks on. This is just the reverse of what ought to take place to obtain the best results and in justice to the apprentice, he should be made to perform the operation, whether it be in the class or in the shop, the instructor advising, in the meantime, as to the best method to pursue.

It might be urged that the proper discipline cannot be maintained; that the fellowship existing between students is too close for one to pay due respect to another's authority. We experience no trouble, because apprentices are given to understand that a code of rules exists for their government, designed to promote their welfare, which must be adhered to. The advantage to the one chosen to assist, is an important factor in favor of the practice: It brings him in contact with the knowledge of others; broadens his views of culture in general and prepares him to meet men in a way he could not without this opportunity.



HINGED MODEL TO ILLUSTRATE ARRANGEMENT OF VIEWS ON A DRAWING.

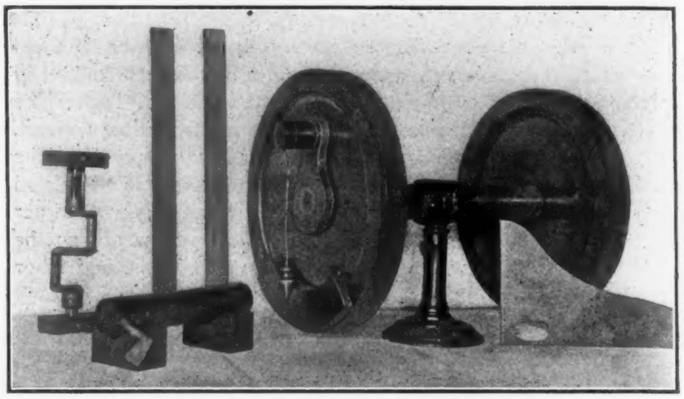
Discussion.—The general opinion was that this is a good idea. Most of the schools are using advance apprentices to assist in breaking in new boys in class work and to help the slower ones with their work. This has been carried to such an extent that while the instructors were attending the conference six out of the nine schools were in operation under the direction of the more advanced apprentices.

The Use of Models to Illustrate Shop Practice.

Mr. C. T. Phalen.—We have constructed a model of a pair of driving wheels, with removable crank pins; also a small plumb square made of wood and wooden straight edges to match. (See illustration.) We find this very valuable for instructing the apprentices during school hours, 3 or 4 at a time, in the methods of quartering. The wheels are 12 in. in diameter and 2 in. thick; the axle is 2 in. in diameter and 14 in. in length. This is mounted on a small pedestal for convenience in handling.

We also have a small wooden axle and wooden V-blocks for use in showing the boys how to lay out keyways. The crank axle shown in the illustration is used in instructing them as to how to finish a piece of this kind in the machine shop.

Discussion.—Each school is now provided with a small vertical engine for use in connection with the study of valve setting. The fact was emphasized that, while at first the experimental work on valve setting in the class room appears a little foreign to setting


SHOP PRACTICE MODELS AT JACKSON.

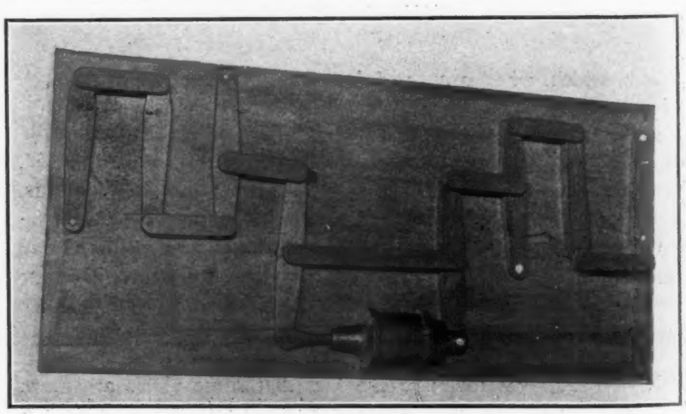
locomotive valves in the shop, it is really closely allied with it and important in making a boy thoroughly familiar with the principles of the slide valve and with parts of the mechanism, which because of the construction of the locomotive valve, cannot be open to inspection. One school is figuring on setting up, under cover, a pair of driving wheels, cylinders, and the valve motion taken from one of the old engines which is about to be scrapped. Most of the schools have a small old type engine lathe installed for instruction purposes. All the schools will, in the near future, be furnished with models of the Walschaert valve gear.

Use of a Hinged Model to Illustrate Arrangement of Views on a Drawing.

Mr. G. Kuch, Sr.—Where the drawing classes are large the hinged model, shown in the illustration, may be used to advantage for illustrating the arrangement of the views on a drawing. The central block is stationary, the other four are hinged on the sides toward the central block, to pieces which slide in the slots. The plan view of the object is first drawn corresponding to the central block. To find the proper relation of the side elevation the object is placed in position for a plan view on one of the side blocks, depending on which side elevation is desired, the block is then turned up; in the same way the top or bottom elevations may be properly located.

Benefits from the Class Work.

Mr. Henry Gardner.—The classroom instruction of apprentices has not been in operation long enough to show a large number of specific instances of benefit at the McKees Rocks shops. The following boys have done high grade machinist work with a skill


MODEL AT McKEES ROCKS TO ILLUSTRATE WORKING OF FOUNDATION BRAKE GEAR.

and accuracy that could not be done by an ordinary boy, without training in mechanical drawing and arithmetic:

J. H. Dwyer, age 27, began apprenticeship in 1905. In May, 1906, he

made from blue print, sketches for a template of the frame tongues on a consolidation locomotive. The template was made and sent to the smith shop and the forgings made from it. The work was correct. He has also set valves unassisted.

F. E. Cooper, age 25, began apprenticeship in 1904. In 1907 he laid off accurately four reverse shafts for some new locomotives, working unassisted from the blue print.

H. Berg, age 25 years, began apprenticeship in 1904. He has set valves on locomotives and has put up shoes and wedges unassisted. He has, by reason of personal fitness and excellence in drawing and arithmetic, served as assistant drawing instructor of apprentices and assisted with the evening classes. He is now employed as draftsman in the main drawing room, doing regular draftsman's work with entire satisfaction.

W. Bollinger, age 18, began his apprenticeship on Jan. 1, 1907. In July he bored six eccentric straps to blue print without assistance, having served only six months apprenticeship.

J. Barr, age 20, began his apprenticeship in 1905. In July, 1907, he laid off six rocker arms from blue print and finished them in the lathe. He also laid off 12 pit jacks from blue print, including I beams, stands, angles and rollers. He assembled these parts when finished without assistance.

S. Langhurst, age 20, began apprenticeship in 1905. In 1907 he laid off a set of ten rocker arms from blue print. The work was done accurately and without assistance.

In cases of locomotive and car tests apprentice boys are always chosen to work in conjunction with the drafting room force. In the case of some air brake tests conducted by Mr. W. P. Richardson, mechanical engineer, in 1905, Apprentices Cooper and Dwyer gave good satisfaction as assistants, doing work usually required of trained draftsmen. From the results thus far obtained, it is quite evident that by the end of another year, a large number of definite cases of important and high grade work done by apprentices can be cited. By that time the opportunities for the boys to show what they can do will have increased, as well as the confidence of the foremen in the boys, and they will then be called upon to take more responsibility and to do more advanced work.

Many cases of apprentice boys doing work from blue prints or sketches, and without instruction, could be stated and are of daily occurrence, but this is expected and is so certainly the result of the class room training that it is not necessary to enlarge upon it. Such beneficial results as increased ability, accuracy, responsibility, manliness and ambition are always noticeable.

Discussion.—The other instructors all presented similar reports. To prevent repetition brief abstracts only have been selected from these:

Mr. H. S. Rauch.—I asked all of our foremen this question: "Do you find any difference in the apprentices with the present system of training compared to the old system?" They all agreed that there was a great difference in favor of the present system, giving the following reasons: The apprentice, a short time after entering the service, is able to work from drawings without any help; formerly a lot of time and patience were taken to explain what was wanted and usually it wound up by having a mechanic, either watch over the boy closely, or do the work himself. The boys have better judgment, make less mistakes and consequently spoil less work. A better class of boys are applying for positions as apprentices. The boys are utilized to make sketches where before it was necessary for the foreman to do this. If any additional assistance is required in the drawing room force it is at hand. One of our advanced apprentices assists me with the school work and during my absence has full charge of the classes, maintaining good discipline. This apprentice, Mr. W. F. Black, is in his third year.

(Editor's note: A shop instructor has not yet been appointed at Oswego so that the improved results there are practically directly due to the school work.)

Mr. G. Kuch, Sr.—Several of our apprentices have advanced in their school work to a point where, if the shop draftsman requires an assistant in the drawing room, they can do the work satisfactorily. A number of the most important machines are being operated by apprentices of only two or three years' training. Several of the apprentices are used for laying out work from blue prints with excellent results.

Mr. Thos. Fleming.—When a machinist lays off and the foreman comes to the instructor and asks him for an apprentice, it does not matter what the job is, it is up to the instructor to see that the apprentice does it in a reasonable time and does it right. Our machine foreman has lots of confidence in the apprentices. There is not a day that we do not have two or more of them working on machinist's jobs. The school is a great help to them in reading drawings, a point where many machinists are very deficient.

Mr. J. S. Lauby.—An important point is the saving of time in the shop due to the apprentice training. Ordinarily a boy when put on a new job feels timid and if left to his own resources does not work the machine to its full capacity. With the shop instructor to prompt him this is overcome and the output is kept up to the standard. We had an apprentice running a planer alongside of a journeyman, who planed all of the driving boxes. An ordinary bent tool was used to dovetail a groove in each flange so that the brass liners might be cast on the boxes. The journeyman used a right hand tool for one side and then stopped the machine and changed to a left hand tool for the other side. It occurred to the apprentice that one tool could be used for both operations and he drew up a design for it. While the tool he designed proved a failure, yet the idea was ultimately worked out and effected a considerable saving of time on this operation.

Mr. C. P. Wilkinson.—Many instances may be noted where the company is receiving direct benefit; one of the foremen was taken ill and all of the laying out portion of his work was handled by an apprentice. We have apprentices on vise work, who are doing first-class work on jobs they never heard of before. One foreman when asked about the system remarked that it was a fine thing to have boys at hand who could pick up ordinary work and go ahead with it without instructions. Another point is that the boys are familiar with the names of everything used and know what they are looking for when they are sent on an errand. This was not true formerly. We now have boys running boring mills and planers, where formerly it was thought that this work could not be done by them.

The Shop Instructor.

The Shop Instructor and the Foreman.

This topic was opened by Mr. J. R. Radcliffe. The foreman and shop instructor should keep in close touch and co-operate with one another. The instructor is responsible for seeing that the boys receive the necessary instructions in their trade. He should consult with the foreman as to the shifting of the boys from one class of work to another. Such an arrangement relieves the foreman of a large amount of detail work, which he ordinarily does not have time enough to give proper attention to, because of his many other duties.

The Shop Superintendent and the Shop Instructor.

Mr. J. S. Lauby.—The ideal relation should be one of closest confidence and mutual understanding. The instructor should be given just enough preference by both the superintendent and the master mechanic to establish his position in the minds of the other employees—foremen, journeymen and apprentices—as being one that is approved by the management and will be supported by it. The apprentice has more confidence in himself if he feels that he has the support of someone that is better qualified than he is, and because of that feeling he can render more efficient service. It is the same with the instructor. If he feels that he is executing the wishes and ideas of the superintendent, he will be quite likely to use extreme caution before promulgating anything out of the ordinary. The instructor should show by conservative judgment that he is deserving of this position in the superintendent's esteem; his conduct, deportment and judgment should be such that when he reports to the superintendent, either in complaint or compliment, the superintendent may feel that the report merits consideration and that he would be justified in approving it.

If this relation exists, many of the petty annoyances that arise from time to time may be avoided by action of the instructor, and the time of the superintendent can be devoted to more serious matters. As the instructor's field covers practically the entire plant he has opportunities for observing, greater than those of any other individual, and his knowledge should be freely imparted on any matter relating to the management's interest.

The instructor should report and be accountable directly to the shop superintendent. This does not infer by any means that he

is to hold himself aloof from the several foremen. On the contrary he should keep in closest touch with them, and endeavor as far as possible to make the changes of apprentices conform to their wishes. If the instructor will keep in mind that working for the interests of the superintendent is working for his own interests, and will reflect credit on him, the best possible relationship is sure to be maintained.

How Many Apprentices Can Be Handled Successfully by One Shop Instructor?

This topic was opened by Mr. Fleming. It depends entirely on local conditions. The shop instructors, of course, devote most of their time to the machine and erecting shop apprentices, as there are ordinarily only a very few apprentices in each of the other trades and the detail instruction of these is left largely to the department foreman, the shop instructor looking after them in a general way only. In a piece work shop, or where the number of machine tools is small compared with the size of the shop, and each one has to be worked to the limit of its capacity to produce the desired output, the boys must, of course, be given more attention than under other conditions. When apprentices are prorated with journeymen they require only a comparatively small amount of attention from the shop instructor.

ONE OF THE OSWEGO APPRENTICE CLASSES IN SESSION.

Shop Training.

Tools for Apprentices.

The general practice at most of the shops is for each apprentice to be furnished, when he starts to work, with a hammer, monkey wrench, and in some instances cold chisels and a center punch; they are also provided with a tool box, drawer or cupboard in which to keep them. The apprentices are expected to purchase inside and outside calipers, a machinist's scale and a rule. While it is not necessary to have a uniform practice in this respect for all of the shops, yet it is advisable that each shop should have a definite and systematic method for handling the boys at the start, as the first days in the shop usually make a very deep impression and it is desirable to get the boys started right.

Should Apprentices Be Started on the Erecting Floor or on the Machine Side?

Mr. F. Nelson.—Judging from our experience with apprentices at West Albany, and taking into consideration the surroundings and inducements offered machine hands by other manufacturing industries in that vicinity, it would seem best to start apprentices on the erecting floor. There are various grades of work, such as stripping, reaming and truck work on which new boys can be used to good advantage, and thus be made familiar with the size of reamers, and the methods of setting up and operating motors. This work should cover the first three to six months in the erecting shop, which would fit the boy to be prorated with a machinist on almost any job in that department. By this plan the company would derive an immediate benefit from the boy's work. It also keeps the boy looking forward to the time when he is to be transferred to the machine shop. When shifted to the machine shop he is familiar with the file, hammer and cold chisel and can be put on almost any bench job; he is able to lay out work and is familiar with the work that may be sent from the erecting shop for repairs.

As the machine shop is the critical point, as concerns the output, it should not be burdened with new boys. The boys started in the machine shop are much older and stronger when transferred to the erecting shop, and consequently feel that they are working at a disadvantage when helping on the erecting floor. They often show by their general conduct that they are dissatisfied and this condition prevails until they are shifted to valve setting, guide work, or shoe and wedge work.

Although there are various things in the machine shop that new boys can do and be of service to the foreman, they do not, during the first two years, grasp as fully the opportunities offered there, as they do during the third and fourth year. If the machine work comes at the end of the course the result is a better grade of mechanics. Earnest observation has led me to believe that the erecting floor is the proper place to start apprentices in order to obtain the best results and to produce the most competent men.

Discussion.—The general opinion was that the boys should be started in on the erecting side. As a rule boys who are not strong enough to do this are hardly desirable as apprentices. The general information they gain on the erecting side, as to the construction of a locomotive, makes them more valuable as machine hands.

Who Should Have Charge of Shifting the Apprentices?

Mr. Frank Nelson.—The shifting of apprentices should be en-

tirely in the hands of the shop instructor for the following reasons:

He comes in personal contact with the boys and is better qualified than the foreman to decide what job the boy is best fitted to be transferred to.

The instructor must have this authority to enable him to enforce the proper discipline.

The boys should look to the instructor for a final decision in any matter under consideration.

If the foreman be given charge of shifting he might, for what appeared to him to be good reasons, shift several in one day to new and scattered jobs. Under these conditions it would be impossible for the instructor to give each boy the necessary direction and attention.

The instructor and not the foreman is held responsible for the future welfare of the boy and the grade of mechanic he makes.

The instructor is wholly responsible for the output of the job upon which the apprentice is working.

When the foreman desires to shift a boy for any reason he should notify the instructor. On the other hand, the instructor should consult the foreman before shifting boys, and they should come to a mutual understanding in regard to the matter.

DOES CLASS WORK DURING WORKING HOURS INTERFERE WITH THE SHOP WORK?

Mr. J. R. Radcliffe.—At McKees Rocks we have 35 apprentices, who are divided into three classes; each class attends school two mornings, or four hours per week. The result is that seven to ten machines are idle for two hours each morning, or a total of from 14 to 20 hours of machine work is lost each day. The absence of the boys from the machines affects the shop output, more than their absence from any other department, since the shop output is most directly dependent upon the machine shop. This difficulty can be regulated to a certain extent by taking boys from floor work and putting them on the machines during the school hours. When necessary a boy may be kept from school to do special work, allowing him to attend school with some other class when the work is finished. If judgment is used in changing boys and holding them to their work, when necessary, the bad effect on the output will be greatly reduced, but in order to accomplish this the "Ideal Relation" must exist between the shop instructor and the foreman.

Discussion.—The situation may be relieved to a certain extent by having the shop instructor advise the foreman of the names of the boys who will attend class on the following morning. A couple of the shops have what is known as a "floating gang" of apprentices, consisting of two or three members who are used specially to take the place of boys who are attending class during the first two hours. The importance of keeping the machine tools working cannot be too strongly emphasized. It is better for the company to have a file lying idle than a machine tool, which may cost anywhere from a hundred to ten thousand dollars.

THE APPRENTICE SYSTEM AND PIECE WORK.

Mr. Frank Nelson.—Piece work is a benefit to the apprentice system. It teaches the boy to establish a systematic procedure whereby he can do the most work in the shortest time. It teaches him to keep his tools in proper condition so that there will be no time lost on the job upon which he is working; it teaches him to be accurate and careful in his work, for if he is not he loses financially. It emphasizes rapidity in his method of doing work and teaches him punctuality. Every moment wasted is a distinct loss to himself.

The apprentice system is a benefit to piece work, for when a boy is first started on a job the instructor's aim is to teach him to do it as quickly as possible, so that he can work piece work, which he is anxious to do, since it increases his day's wages. Piece work induces a better grade of boys to learn the trades, for they feel that in this way they have an opportunity to get a practical education and at the same time a chance to earn sufficient wages to supply their needs while learning the trade.

GROUPING BOYS FOR INSTRUCTION ON MACHINES.

Mr. P. P. Foller.—Viewing the matter from a practical standpoint, I feel quite confident that very little good would result from a demonstration of machine practice to groups. As a rule, the boys are those who have had but little practical experience in operating machines, consequently such demonstrations would approximate "book training" and would be of little practical assistance.

I find no better way of educating a boy for machine work than that of the old-time practice, *i. e.*, to start each boy on the simplest line of machine work and if he shows an adaptability to become a machine hand then advance him, step by step, until he has reached the highest grade of machine work.

OILING AND CARE OF MACHINE TOOLS.

Mr. C. T. Phelan.—The necessity of taking proper care of their machines should be impressed upon the minds of the apprentices through the instructors. This should be done at the very start and should be religiously followed up.

DETACHING A BOY FROM HIS REGULAR WORK TO ASSIST ON AN ESPECIALLY INTERESTING JOB.

Mr. C. T. Phelan.—This is a good scheme, although it is not regularly practiced at Jackson. In doing it care should be taken not to interfere with his regular work to any great extent.

Discussion.—A certain amount of such work is advisable, but it should not be overdone.

THE RATE OF PAY FOR GRADUATE APPRENTICES.

A graduate apprentice should be paid at the same rate as a journeyman who is taken in from outside. Certainly the boys who have spent four years in the shop, receiving a thorough training in different classes of work and with the advantages which they have gained from their school work, are worth at least as much as the man who is taken in from the outside. In order to keep the boys in the company's service they should be paid at the same rate.

Apprentice Auxiliaries, Etc.

APPRENTICE CLUBS.

Mr. C. A. Towsley.—The need of an organization that would appeal to the young men of the Elkhart shops was realized by our former master mechanic, and present superintendent of apprentices, Mr. Cross, and through his efforts an organization was perfected a number of years ago; the success of the club has been very gratifying. The objects are, first, to create a feeling of fellowship and thus bind the apprentices of the different trades closer together; second, to provide for their intellectual, moral and physical welfare.

The place of meeting should be in, or adjacent to, the school room, in order that the members may have access to the school apparatus, blackboard, library, current magazines and collection of blue prints. The room should be made to look as inviting as possible, with pictures on the walls and the books and periodicals placed conveniently.

The Elkhart Club aimed to ultimately raise the tone of the workmen and to develop from among the boys earnest workers, who, perhaps without bright and helpful associations, would have been content to remain in the narrow confines of the laggard. This desire has been realized to a certain extent and a number of its members have broadened out and are taking advantage of the opportunities offered. Several have had hidden talent cultivated and are now holding jobs that will eventually lead to positions of importance. This is a possibility in every club and the officers should see that the efforts of the careful, painstaking worker are recognized and that he is given all possible opportunity to broaden and develop. The lectures, papers and discussions should embrace subjects which tend to awaken the interest of the listless ones and to stimulate interest already awakened. Practical talks by different foremen, on their special line of work, bring out valuable points for the apprentice and broaden the ideas of those in other departments. A forceful method of illustrating different operations is the use of the reflection lantern, by means of which photographs, blue prints, and magazine illustrations may be projected upon the screen.

The regular meetings of the club will give the members a

knowledge of parliamentary practice. They will also develop a feeling of independence from the fact that the meeting is their own and is officered and managed by their own members. Subjects may be assigned to members to be presented in the form of a paper. This can be followed by a debate in which all members should be urged to take part.

Another point that might be of benefit in maintaining a spirit of independence would be a small assessment, quarterly or semiannually, which would also provide for any emergency which might arise and would avoid the necessity for levying a large special assessment. The library consisting of reference books and periodicals should be regarded as an essential part of the school and club. The boys should be urged to make use of the room, outside of shop hours, and especially during the noon hour, when the instructor is on duty.

Discussion.—The idea of apprentice clubs was received very favorably, but the problem of getting the boys interested in such a club at a shop where most of them live a long distance from it, is a rather serious one and means that the inducements must be made especially attractive in order to get and keep the boys interested in it.

The Elkhart club expects during the coming winter to have a series of talks which will cover the complete building of a locomotive. These meetings will be very informal and the boys will be expected to ask the speaker questions.

Each club room should be supplied with a file of such catalogs, as might be of interest to the boys, and a number of technical papers, the latter to be supplied by the railroad company.

The Value of an Apprentice Baseball Team.

Mr. R. M. Brown.—A baseball team is an important factor among the apprentices or employees of a railroad shop. The success or failure of the team hinges closely upon one thing, "organization." Any one who is at all familiar with baseball, knows how utterly helpless an individual or a team would be (no matter how quick or skilful), without the aid of the other players. Every man's success depends upon his ability to work with those around him in an organized body, each helping the other and all working and pulling in one direction toward success. Team work is what counts, whether it be in baseball or shop work, and an apprentice baseball team properly managed, and duly recognized by a sympathetic shop management, will improve the efficiency of the apprentices.

A baseball team is also a means of getting the boys acquainted, not only with each other, but with the men. This is especially true where games are played with the shop men or with the officers. Without in any way interfering with the proper relations between the boys and the company officers, the team can be the means of making many of the boys personally acquainted with their superiors.

Another feature of the baseball team is the advertising effect. One would be surprised at the number of boys in Cleveland, for example, who have never heard anything about the apprentice system of the New York Central Lines. One of the Collinwood apprentices, who appeared on an amateur baseball diamond, rigged out in his apprentice uniform, had to answer many questions about the team, shop and pay. As a result, a number of boys have called at the instructor's home to inquire about the apprentice trades at the Collinwood shops. The newspapers are always glad to publish the results of games played, which serves both to encourage the team and to give publicity to the apprentice movement.

A baseball team also plays a part in making a boy contented and happy to stay in the service. It is but one factor, and yet experience has shown that it is an important one, and that the organization of a team may turn a fault-finding and grumbling apprentice into one who is not only proud of his team, but also of his shop and its officers.

It is perhaps conceivable that with unwise management of a team, or with shop officers who fail to realize its value, there might be disastrous results, but happily the apprentice teams thus far have been well managed and the company officers have always stood ready to encourage, accommodate and help.

Discussion.—The Collinwood and Elkhart teams played a couple of games together, the drawing instructors accompanying the teams on the trips. This gave them an opportunity of getting better acquainted and closer to some of the boys than would have been possible otherwise. The games were played on Saturday and the members of the teams, therefore, only lost part of the day from their work. The expense of the suits and other equipment was provided by subscription. In connection with the discussion of this subject the matter of annual apprentice picnics was brought up and was favorably regarded.

THE APPRENTICES AT THE JACKSON SHOPS—MICHIGAN CENTRAL RAILROAD.

An Apprentice Button.

Discussion.—It was agreed that it would be advisable to have an apprentice button which would be furnished free to each apprentice in good standing. It was suggested that it might be a good idea to furnish this button only after the apprentice had completed a certain amount of work in the problem and drawing courses. The idea of having a graduate button was also suggested, this to be paid for by the boy.

To What Extent Should Apprentices Be Sent to Visit Other Shops?

Mr. Frank Nelson.—Boys should be sent on visits of this kind

at least once, and if possible twice during the year. The benefits may be summed up as follows:

1. The advanced ideas obtained which may aid them in their work.

2. The information derived by comparing the various methods of working with those already learned.

3. The opportunity of seeing different types of machinery and equipment.

Allowing the apprentices to make short trips to other plants has proved very successful with our boys. Although it is a year since they visited the General Electric Works and the American Locomotive Works at Schenectady, N. Y., in almost every conversation held since with one of the older boys about doing work he refers to methods in use at these plants.

Several of the boys obtained ideas which they put into use at once; one boy who was working on a boring mill changed the method of fastening the tires on the table to correspond to the methods he had seen at Schenectady. He did this without waiting for definite directions from the instructor, and soon found that he was able to gain one tire in his day's work. The impression made on the minds of the boys by observing the methods of experienced workmen prove much more lasting than when these same methods are explained ever so clearly by their instructors. It is a paying proposition to the company to allow either boys or men to visit other shops where work of a similar kind is being carried on.

The boys, after the above mentioned trips, were asked to write letters to the shop foreman as to their observations and what they had learned. These demonstrated the benefits which were gained.

How Can the Apprentices of the System Be Brought Closer Together?

Mr. A. W. Martin.—The following is a suggestion as to one way in which the apprentices at the various shops may be made known to each other. Let each drawing instructor select twelve drawing sheets and twelve problem sheets each month, four from the most advanced third of his apprentices, four from the middle third, and four from the least advanced third of his classes. These to be forwarded to the New York office and sent around to the various schools in succession and posted, say for three days at each place. As the shops are all using the same courses, the boys would be able to tell by inspecting the posted sheets the progress which was being made at the different points. This would arouse interest and rivalry. It would be advisable to have attached to each drawing sheet a slip of paper showing the trade at which the boy is working and the date when he started in the apprentice school. Thus in time the leading boys of the system would become familiar with each other's names and progress. The scheme would also keep the various instructors in closer touch with one another, as in looking over the sheets they could get an insight into methods used at other schools.

Evening Classes.

Evening Classes for Foremen and Mechanics.

Discussion.—It was decided that the methods of teaching should be about the same as for the apprentice day school classes. Important results may be obtained from these classes, and quickly, if the brighter and more ambitious men are selected from the shop. The ground to be covered would be about the same as that in the apprentice classes, the simpler parts of it being presented in the nature of a review.

This evening work should consist largely of mechanical drawing, as it has been found during the past year that the men took more interest in this than in the problem work. The number of men in the class should not exceed 15 or 20 unless the instructor has an assistant, when double that number can be handled to advantage. The evening classes should not continue after April 1.

In answering the question as to whether compensation should be paid in advance, regardless of attendance, the general opinion seemed to be that, except in a few instances, advance payment would not insure better attendance. At some of the shops the management has excused men from overtime to attend these classes. It was suggested that it would be well to block the work out for at least three months in advance.

Evening Classes for the Instruction of Mechanics in Shop Practice.

This is desirable and would probably be more successful if organized in the form of a club. Excellent facilities for demonstration may be found in connection with the actual equipment in a railroad shop which, in addition to a reflection lantern, could be used to splendid advantage for this purpose.

Abstract of Mr. Gower's Talk.

During the past two days I have come face to face with what I consider the solution of the apprenticeship question. It is one of the most important questions of the day, and when dealing with it you are undoubtedly paving the way towards a satisfactory settlement of the labor problem.

I believe yours is the only company in the United States, and probably in Europe, which has dealt with this apprenticeship problem upon sound and business-like lines, and your work is bound to bear good fruit in the immediate future.

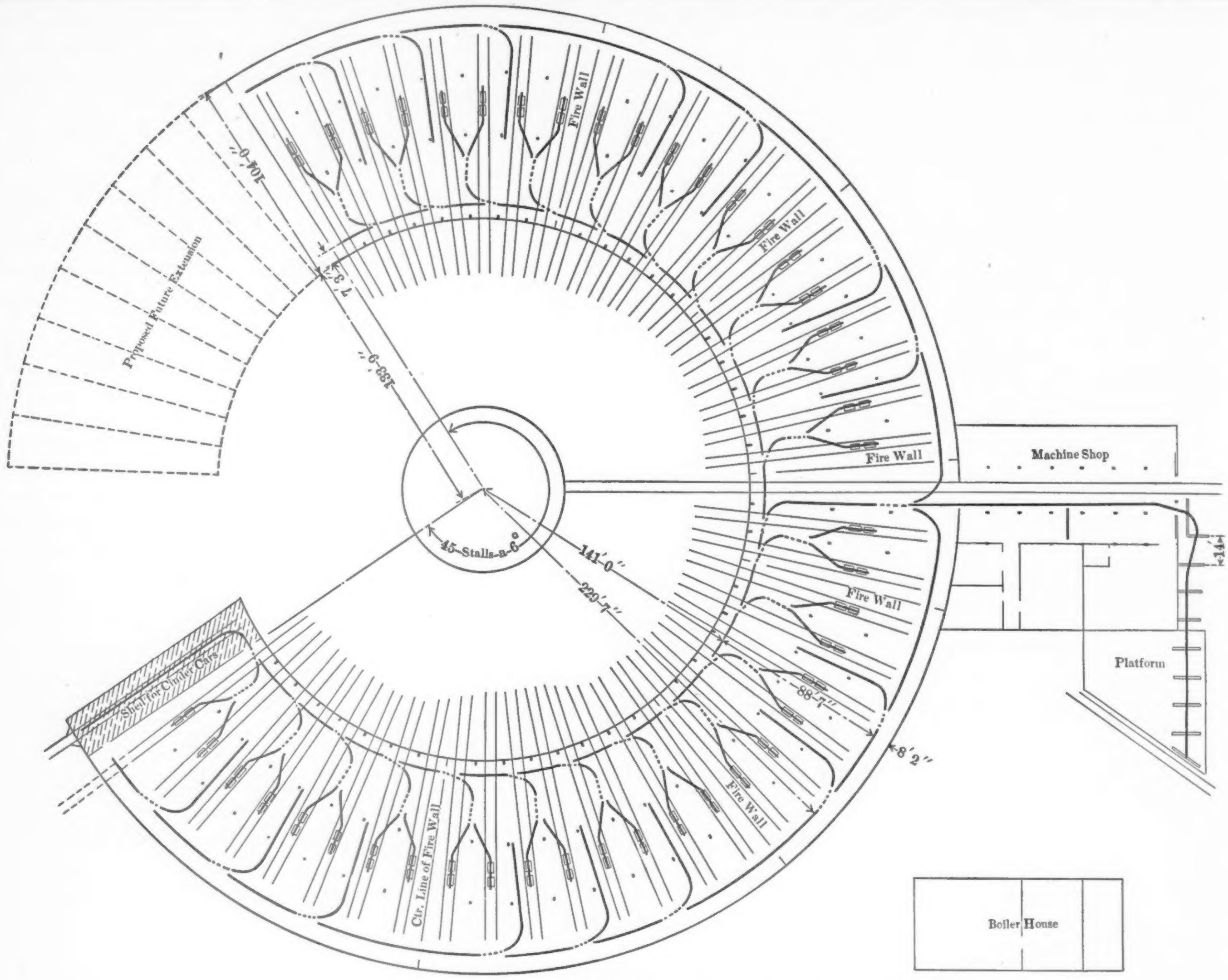
I have had many opportunities for studying the apprenticeship problem in Europe, but though several of the great European railroads and industrial firms are equipped with schools, they apparently, have not yet succeeded to the extent that the New York Central has. In my opinion the fault lies in people failing to differentiate between work taught in a concrete form and work taught in the abstract. This apprenticeship question may be looked at from two points—the educational side and the moral side. A great deal of stress is being laid on the educational side, but to my mind the most important factor is the moral training, which it is essential our boys should receive, for as we now train the boys so will our men be in the future, therefore it is essential that every care should be taken to train them to become honest, straightforward, well disciplined and self-respecting men who will be conversant with shop organization and realize that foremen are appointed by employers, not for the purpose of standing over them to see that they do their work, but to allot and give out the work required by their employers.

The word "independence" is frequently on the lips of all Americans, but independence and education go hand in hand, for the man who is trained and thoroughly master of his work can rightly claim independence and freedom, but the untrained man has to depend upon others to assist him.

It is primarily essential that a boy should be taught to think, but not merely to think, but to think in measurable quantities, and if you are able to instill into a boy's mind the principles underlying his trade you will find that he will quickly learn the details, as his mind will be trained.

As your object is to train skilled mechanics it is necessary for the instruction to be gradual, advancing by easy stages—you cannot go too slow. The men and boys who aspire to higher posts will take care of themselves. Arrange the work to meet the needs of the most backward of your boys. Your aim is to train skilled and competent workmen and not walking calculators or chief draughtsmen.

The ideal method for teaching working men is to place the actual piece of material before them and not allow them to study anything in the abstract. This method I am pleased to see you are establishing in all your schools. The machinist when learning mechanical drawing should have the actual machine or engine part before him. Let him make a rough working sketch, check his own measurements and then make a rough pencil drawing of two or more views, inserting the necessary dimensions. Instruction papers containing calculations and particulars about that piece of mechanism should be given to him when he is making his drawing. This method is preferable to the blue print system of teaching and is more likely to bring good results. Let your instruction be as practical as possible, and I cannot sufficiently emphasize upon you the necessity for all such instruction to be slow and thorough, and if so it will surely be beneficial.



PLAN OF DILWORTH, MINN., ROUNDHOUSE—NORTHERN PACIFIC RAILWAY.

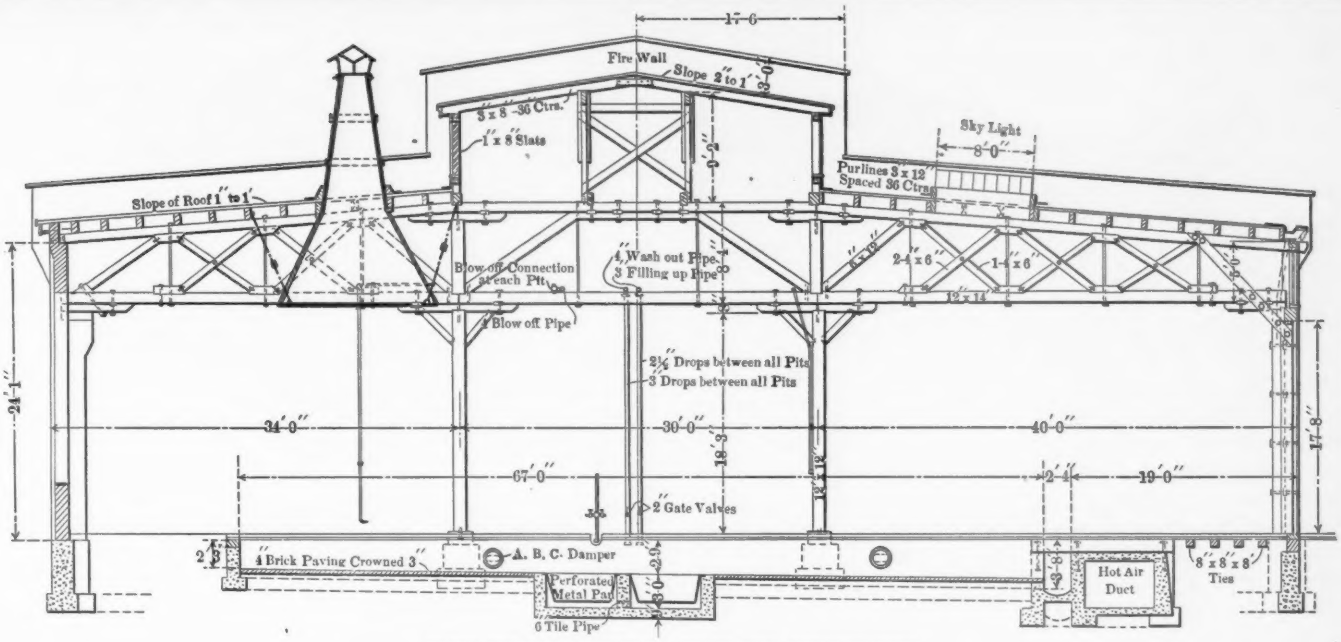
AN IMPORTANT DEVELOPMENT IN ROUNDHOUSE DESIGN AND OPERATION.

NORTHERN PACIFIC RAILWAY.

A new roundhouse, having some very radical improvements in design and operation, will shortly be placed in commission on the Northern Pacific Railway at Dilworth, Minnesota. The idea, which has been developed by Mr. David VanAlstyne, formerly mechanical superintendent, is to facilitate the handling of engines, especially during severe winter weather when the efficiency of the power is often reduced to an extremely low point, due to inadequate terminal facilities. To accomplish this, arrangements have been made to bring the locomotives directly into the roundhouse as they come off the road, taking time only to coal, water and sand, it being possible to clean the fires on any pit in the house. This will not only make it possible to handle them more expeditiously, thus materially increasing their efficiency at a time when they are needed most, but a considerable saving of fuel will be effected, the expense of hostlering will be reduced and boiler troubles will undoubtedly be relieved to a large extent.

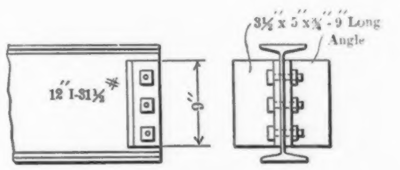
Unfortunately at most terminals the engines usually come in in groups, several arriving at about the same time. While waiting their turn at the cinder pits they often freeze up badly, and this and other treatment which they receive at the hands of the hostlers while waiting, causes more or less boiler leakage. With the new arrangement the engines will be taken directly into the house and the roundhouse force will start to work upon them while they are thawing out. At present the firemen are required

OVERHEAD CONSTRUCTION FOR SUPPORTING I-BEAM TRACKS.

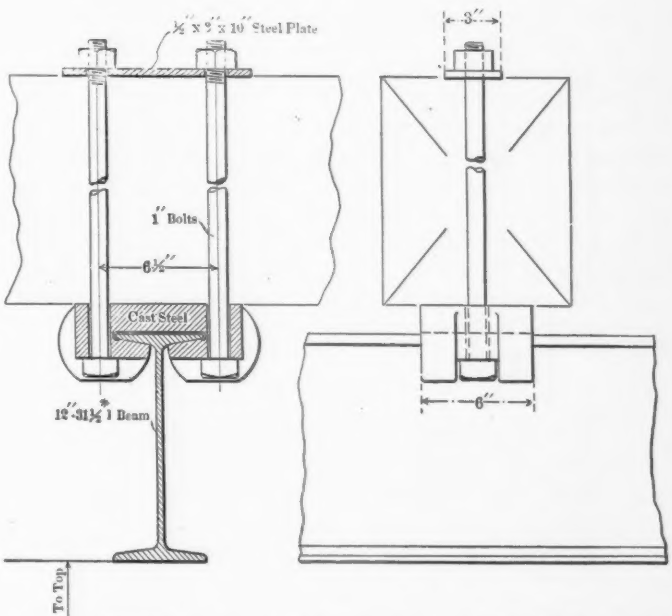


CROSS-SECTION THROUGH DILWORTH ROUNDHOUSE.

to bring the engines into the terminal with a good fire, but under the new conditions this will be unnecessary, thus effecting a considerable saving in coal. The practice of renewing the fires while the engines are waiting in the yard will also be done away with. Ordinarily the nostler and cinder pit gangs are either overworked or do not have enough to do to keep them busy. With the new roundhouse their work can be arranged to better advantage, materially increasing their average efficiency. As the fires will be allowed to die out gradually, or after being cleaned will be banked, the boilers will not be subjected to extreme and rapid changes of temperature. Steam blown off from such boilers as it will be necessary to wash or repair, will be utilized for heating the roundhouse, or will be blown into a hot well. To bring



SAFETY STOPS AT ENDS OF TRACK.

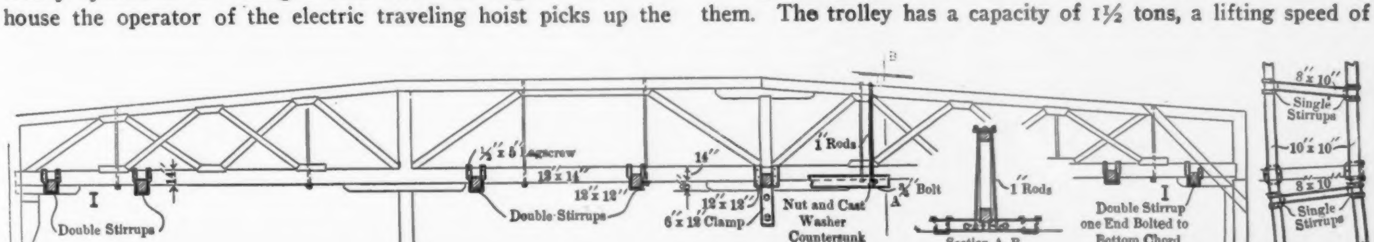


METHOD OF ATTACHING I-BEAM TRACK TO CROSS TIMBERS.

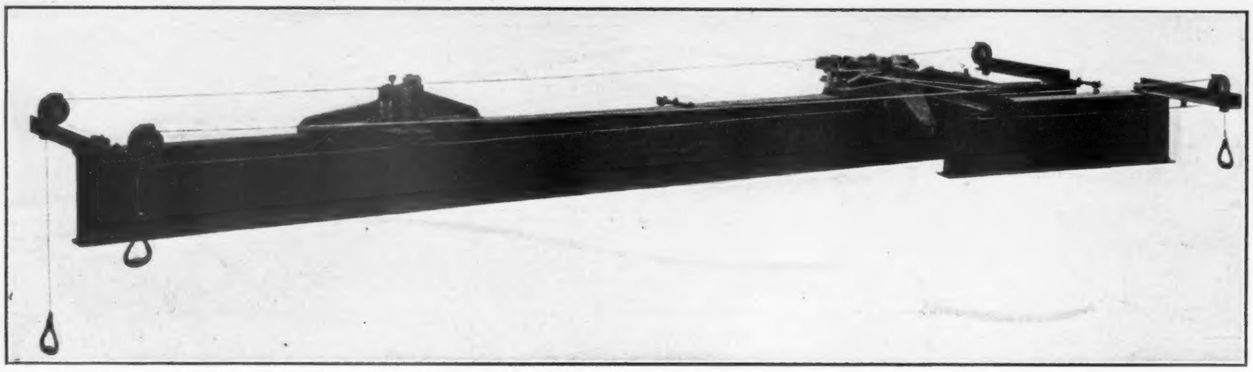
about this result it was of course necessary to add considerably to the first cost of the roundhouse, but the resulting increase in the efficiency of the power, especially during the colder weather, will, it is expected, many times repay this.

The roundhouse is of brick construction with wooden framing, and has 44 pits, with provision for 9 additional ones should they be required in the future. The plan view shows the general arrangement of the house, with the machine shop, store house, and power plant at one side. The cross section of the house shows the construction of the engine pits; in each of these are two sub-pits, which are normally full of water, each containing a perforated metal pan 6 ft. long and about 30 in. deep. The cinders are dumped into one of these pans and the overhead trolley system is so arranged that when the engine leaves the house the operator of the electric traveling hoist picks up the pan, takes it around the inner circle of the roundhouse and dumps it in a car in the cinder shed. He then returns the empty pan to the pit and if the other one is filled, empties it in the same way. Each pan has a capacity sufficient for a large fire, so that if one engine is placed over the pit as soon as another one is taken out there will be room for its fire.

The electric traveling hoist operates on the lower flange of 12 in., 31½ lb. I-beams. The arrangement of the tracks is shown on the plan view; there are 60 two-way switches and one three-way switch. Other views show the arrangement of the framing for supporting these I-beams and the detail methods of attaching them. The trolley has a capacity of 1½ tons, a lifting speed of



GENERAL METHOD OF ATTACHING I-BEAM TRACKS TO ROOF TRUSSES.

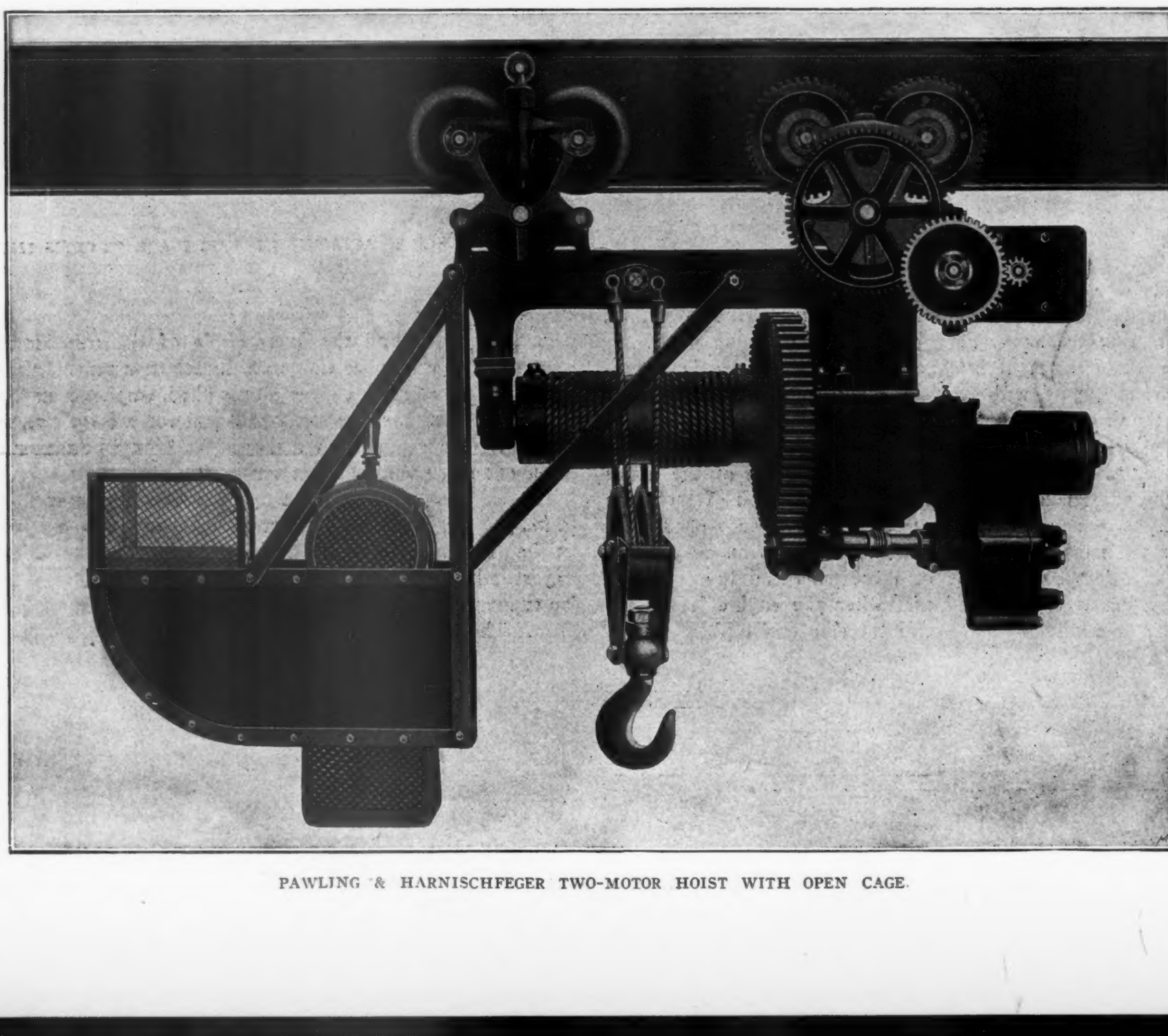


ARRANGEMENT OF TWO-WAY SWITCHES—DILWORTH ROUNDHOUSE.

36 ft. per minute at full load and 60 ft. per minute with no load. The trolley speed under full load is 250 ft. per minute and with no load 350 ft. When not in use carrying ashes the hoist may be used at the front end of the roundhouse for such work as handling front ends, cross heads, pilots, steam chests, etc. The switches are operated by handles attached to the ends of wire ropes. They are so arranged that there is no danger of the trolley running off at an open switch unless the wire rope handles are tampered with, and as these are 15 ft. above the floor there is little danger of this. Although the trolley runs over the drop pits it will be used only for tender and engine truck wheels. A special 5-ton trolley hoist, which is hand operated, will be used for the driving wheels, it being possible to run this hoist into the machine shop and over the driving wheel lathe. The electric trolley will also operate through the machine shop and out over the casting platform. It was furnished by Pawling & Harnischfeger, of Milwaukee, and is known as their two-motor hoist with open cage. It is provided with electric head lights at both ends to enable the operator to see his way in the night time. The power for the plant is furnished by a 165 kw., 60 cycle, 220 volt, 2 phase, direct driven generator. Direct current at 220 volts, for operating the trolley hoist, is furnished by a motor-generator set.

A four-inch pipe for filling the boilers and a five-inch pipe for washing them out extend around the house above the bottom members of the roof trusses, with drops between every other pit. There is also a 5-in. overhead pipe line into which the engines are blown off. During the winter time the steam passes from this into the hot air heating apparatus, the surplus being blown into the hot well. The fan engine also exhausts into this line. The exhaust pipe extends 10 ft. below the water level in the hot well, so that there will always be about 5 lbs. back pressure. The engines, air compressor and pumps exhaust into the hot well through a similar pipe. A by-pass is placed between these two pipes and is so arranged that the exhaust from the power house and from the blow-off can either all be used in the heater, or part of it can be used for this purpose and the rest be blown into the hot well, or all of it can be exhausted into the atmosphere by means of the back pressure valve in the power house. A live steam pipe also leads from the boiler room to the hot well.

In a test, recently made, the power house was operated at its full capacity, as was also the hot air heating plant. The extra exhaust steam was turned into the hot well, heating it up to over 200 degs. F. The large washout pump took the water at this temperature and delivered it to the two farthest washout



PAWLING & HARNISCHFEGER TWO-MOTOR HOIST WITH OPEN CAGE.

hydrants in the roundhouse; the 2-in. valves were wide open and the pressure was greater than the boiler pressure operating the pump.

An underground blow-off system is being installed, with connections between the pits, so that engines which are to be washed out may be connected through the blow-off cock, and the dirty water blown into an underground tank which overflows into the sewer. We are indebted for information and drawings to Mr. W. L. Kinsell, mechanical engineer.

ENGINE FAILURES.

By J. F. Whiteford.*

Engine failures probably receive more attention than any other one thing in connection with the operation of a railroad, since, when the engine stops, the revenue and all things attendant thereon suffer. Without a well defined system governing the handling of failures it is evident that much energy can be wasted, as the improper charging of failures often results in prolonged debate between the mechanical and transportation departments, which time could be used to better advantage in improving the service.

Engine failures are reported for two reasons:

First: To afford explanation of delays to traffic and affix responsibility.

Second: To furnish such information as will assist the mechanical department in correcting imperfections in design and workmanship.

Delays to traffic will occur as long as railroads are operated, and as an abstract proposition it is immaterial whether the delay ensues from power, rolling stock, roadway or transportation difficulties, but in the interest of the betterment of service, it is imperative that all reports be accurate and that each department bear its own responsibilities.

Delays charged to "engine not steaming" which in reality were due to the inefficient appointing of meeting places, or "working on engine" when a hot box was being cooled on a car or where the improper distribution of ballast destroyed the efficiency of the cylinder cocks, have no tendency toward improvement and these illustrations serve to indicate the necessity of a well defined system of reporting and tabulating failures.

It seems essential, in a discussion of this subject, that the following be considered.

A concise definition of an engine failure.

A proper method of reporting and tabulating failures.

A satisfactory basis for comparing failures.

A systematic course for improving conditions.

Owing to the various causes which may retard the departure of an engine from a roundhouse, it does not seem proper to include terminal delays in the list of failures. These should be handled independently and only such delays as result after the engine is in actual service should be considered, as failure reports should serve as an indication of the condition of power.

All delays to traffic due to the condition of the engine, which are not afterwards overcome, should be charged as failures, but the value of the reports diminishes rapidly when failures are listed that were the immediate result of excessive delays on side tracks, damaged rolling stock or bad condition of the roadway. This emphasizes the necessity of stringent rules covering these details, as failures once charged should never be cancelled.

It is obvious that the mechanical department knows more about the handling of power than the transportation department, and that the latter knows more about the handling of trains than the former, so that it should not be a difficult matter to properly define an engine failure, but when discussions are permitted relative to the charging of a failure, which was primarily due to transportation or roadway difficulties, it is essential that rules be made to cover all these details and when once made, that they be rigidly enforced.

Since the effect produced by those causes which tend to decrease the efficiency of a locomotive, varies with the size and service of the engine, the water conditions and the topography of the country, it is improbable that a definition of a failure could be arranged that would be universal in all sections of the country, though it is possible to have one common in part, if not in entirety, leaving the adjustment of the details to those in immediate charge. These, when once arranged, would enable the train dispatcher to charge all failures correctly upon the receipt of a separate report from the conductor and engineer, which ruling should be effective in order to effect uniformity in all reports of delays and remove the liability of errors.

A telegraphic report, to be followed by a copy by mail, of all failures where the engine is concerned, should be furnished each morning to the heads of all departments, and the roundhouse foreman should have complete information of failures, so that a thorough examination and subsequent report can be made immediately on the arrival of the engine at the terminal.

A blank form should be furnished the engineer to be filled out on his arrival, permitting the mentioning of such details as may be necessary to supplement the telegraphic report, and his statement, together with the one from the roundhouse foreman, should be in the master mechanic's or division foreman's office within five hours after the arrival of the engine.

Where machinery is broken, a "defective machinery blank" properly filled out should accompany the other reports, as the cause of all failures of power cannot be followed too rapidly or too thoroughly.

Provision for the handling of these reports beyond the master mechanic's office should be made to suit conditions on each individual road in order that imperfections in design may be corrected as early as possible, and instances of inferior workmanship may be handled as conditions permit or necessities require.

A monthly report where all the failures occurring on each operating division are shown, should be issued and all failures itemized as follows:

Hot Bearings	*Machinery*
Driving boxes	Piston loose
Engine trucks	Piston bent
Tender trucks	Piston gland broken
Eccentrics	Piston heads broken
Crank pins	Piston follower broken
Etc., etc.	Etc., etc.

A suitable comparison should be made as regards the total failures on each division with the preceding month or that of a year previous.

Since the monthly report cannot reach the various division offices for three or four weeks after the last of the month, the writer has found it of considerable advantage to separate the failures shown on the daily reports into the following general heads:

Air	Machinery
Blow-off Cocks	Oil Burners
Grates	Foaming
Hot Bearings	Leaking
Injectors	Not Steaming
Miscellaneous	

By such a system, an unusual number of failures of any one of the foregoing classes are readily discovered and such action immediately taken as may be necessary for improvement. Much good may be accomplished by the master mechanic's office furnishing the various sub-foremen with a copy of the failures for each week with comparison of the preceding week, showing the failures of each class on engines leaving the various terminals separately.

A satisfactory comparative basis is very necessary, as otherwise it will be impossible to make accurate comparisons of different divisions for the same period and of the same division for different periods, but after a thorough investigation of the situation, it appears that the common comparative factor—average mileage per failure—is not only inadequate but very misleading, as numbers only are considered, regardless of the variations of detriment to the service that result from the failure.

Since the primary reason for the reporting of failures is to

* General Roundhouse Inspector, Santa Fe.

explain delays to traffic, it is imperative that the extent and importance of the delays should be considered in making comparisons, as a delay of eight hours is more detrimental to the service than one of five minutes, and delays to passenger trains are of more relative importance than those to through freight and the latter in turn are more important than those to local and switch service.

In the days when engines were of the same size and total failures were the only ones counted, the necessity of checking delays was not as vital as at present. The number of failures only was sufficient for comparative purposes, but since a failure may be anything from a three-minute delay to where the engine gives up the train, it is evident that the numerical feature is not sufficient.

A storekeeper whose records of a stock of pipe consist of the number of feet of pipe, regardless of the diameter or quality, would be in bad shape, which illustrates that the number of failures are meaningless without some additional information relative to the damage to the service, and while this may necessitate more clerical work, I am of the opinion that the needs justify the expense, as otherwise it will be impossible to determine whether any improvement is being effected.

For example, consider the following failures:

Eng.	*Train*	*Time*	*Cause of Delay*
107	4	2 hr. 40 min	Broken piston rod on air pump. Delayed No. 4, 2 hr. 40 min. waiting for No. 77's engine. Delayed No. 77, 6 hr. 30 min. waiting for another engine.
1732	33	1 hr. 55 min.	Blew out cylinder head, reduced to 40 per cent tonnage.
2821	Loc. E	20 min.	Packing hot box on engine truck.
2112	Switch	30 min.	Broken brake rod. Delayed yard work 30 min. while engine went to roundhouse for repairs.

The foregoing failures, varying from a total failure where a limited train was delayed two hours and forty minutes and a fast freight six hours and thirty minutes to that of a failure where a local train was delayed twenty minutes, while differing largely as to extent and importance of the delay to traffic, are all of the same value where numbers only are considered.

It seems advisable to divide failures into three divisions, namely: passenger, time freight, local and switch.

These divisions when all failures are reduced to a total hour delay in the first and third classes and a tonnage hour delay in the second class, would enable very satisfactory comparisons to be made and those in charge of operation would be able to determine accurately, from the monthly report showing the total delays resulting from failures, the extent of improvement or otherwise on any and all divisions. Under the present system, ten failures of five minutes each are considered of more consequence than five where the engine fails entirely and gives up the train, which is incorrect altogether, since the service was impaired more in the latter case than in the former.

For the improvement of conditions or the diminishing of failures, it seems necessary to have a prompt, explicit and correct report followed by a thorough investigation and the necessary action taken to correct imperfections in design and workmanship.

Efficient supervision is the only remedy and should exist not only in the roundhouse, but on the road, as many failures due to carelessness on the part of the workman could have been avoided if the enginemen had given their engines the proper attention.

When one engineer can run an engine successfully without a failure for six months and another on the same service under identical conditions has an average of one failure per week, it indicates that much improvement can result from the co-operation of the enginemen.

However, but little good can result from asking an engineer to "please say why" he had a leaking failure after he had remained on a side track an excessive time, or a hot bearing when it was necessary to use a freight engine for passenger service, which again illustrate the necessity of a concise definition of a failure, as the engineman should get full credit for meritorious service in this respect.

In connection with the proposed methods of tabulating engine failures, the monthly report could be arranged so as to show the total delays resulting from each individual engine, which in cases of assigned engines should serve as a record of individual engineers. The establishing of a system of giving merit marks according to the decrease in delays, would have a good effect. A report of this nature would permit the condition of each engine in service to be reflected without the introduction of individual foreman's opinions, as the first report is usually correct, while the latter is only a matter of conjecture.

A rigid inspection on the arrival and departure of an engine at a terminal by both the engineer and roundhouse man, and the constant attention of the enginemen while on the road, will serve to improve the service of a locomotive, and with such corrections of imperfections in design as may be determined from the reports of failures, is all that those in immediate charge can accomplish, though the care of an engine both on the road and at the terminal should occupy the attention of all in the operating department.

TESTS OF GAS ENGINES WITH ALCOHOL FUEL.

Bulletin No. 191 of the U. S. Department of Agriculture, recently issued, contains a full account of a series of experiments made for the purpose of testing the adaptability of the present designs of gas engines in America to run on alcohol as fuel, as well as the efficiency and action of this fuel as compared with gasolene or kerosene. Tests were made on eight different engines, including one, two and four cylinder and two and four cycle engines, for both low and high speed. A sufficient number of runs were made with each engine to obtain uniform and accurate data. The conclusions drawn as a result of this investigation are:

1. Any gasoline engine of the ordinary type can be run on alcohol fuel without any material change in construction. Difficulties likely to be encountered are in starting and in supplying a sufficient quantity of fuel, a quantity which must be considerably greater than the quantity of gasoline required.

2. The operation on alcohol is more noiseless than gasoline; the maximum power is materially higher and there is no danger of injurious hammering.

3. Alcohol seems to be especially adapted as a fuel for automobile air-cooled engines, since the temperature can rise much higher than with gasoline before auto-ignition takes place.

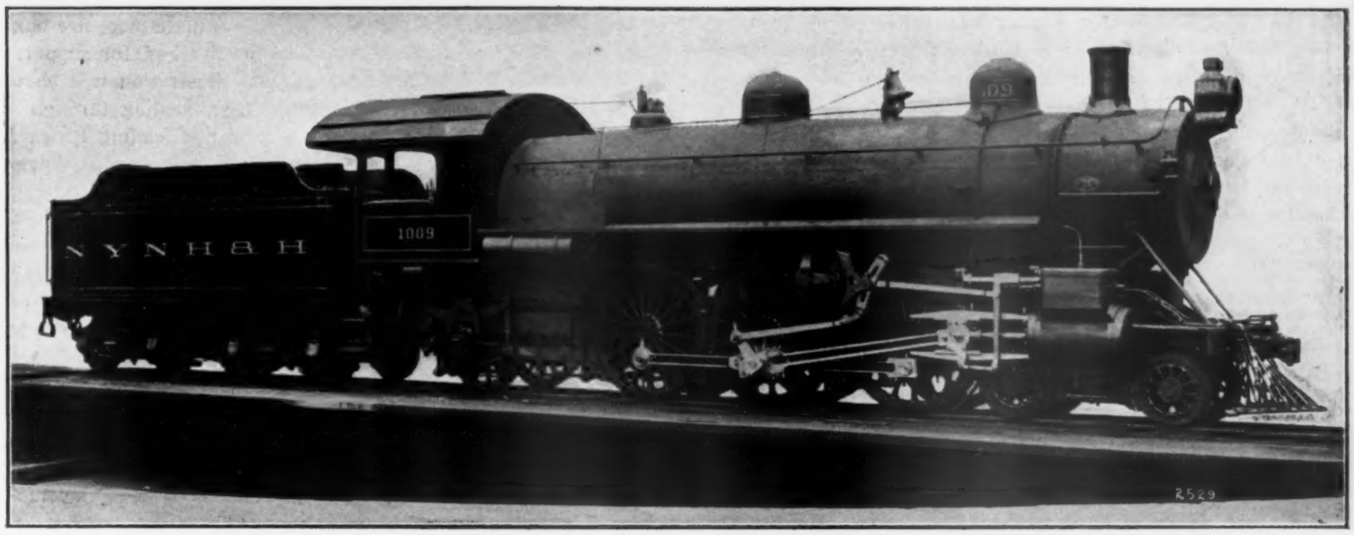
4. The consumption of fuel of any kind in pounds per brake horse-power depends chiefly upon the horse-power at which the engine is being run and upon the setting of the fuel supply valve. It is easily possible for the fuel consumption to be double its best value, either by running the engine underloaded or by a poor setting of the fuel supply valve.

5. So far as tested the alcohol fuel consumption was better at low than at high speeds. Increasing the initial compression from 70 to 125 lbs. produced but very slight improvement in the consumption of alcohol.

6. With any good small stationary engine as small a fuel consumption as .7 lbs. of gasoline or 1.16 lbs. of alcohol per brake horse-power hour may reasonably be expected under favorable conditions. These values correspond to 0.95 pints of gasoline and 1.36 pints of alcohol.

REPORT OF CAR SURPLUS AND SHORTAGE.—The report of the committee on car efficiency of the American Railway Association, given in statistical bulletin No. 7, shows that on September 18, on 172 roads, the surplus of revenue freight cars was 13,231 and the shortage 64,929. On October 2 reports from 149 roads showed a surplus of 6,202 cars and a shortage of 64,013.

PASSENGER TRAFFIC ON THE LONG ISLAND RAILROAD.—During the first eight months of this year the Long Island Railroad carried 16,831,076 passengers, an increase of nearly two million over the number carried in the same months of last year. This is an increase of 11.6 per cent.

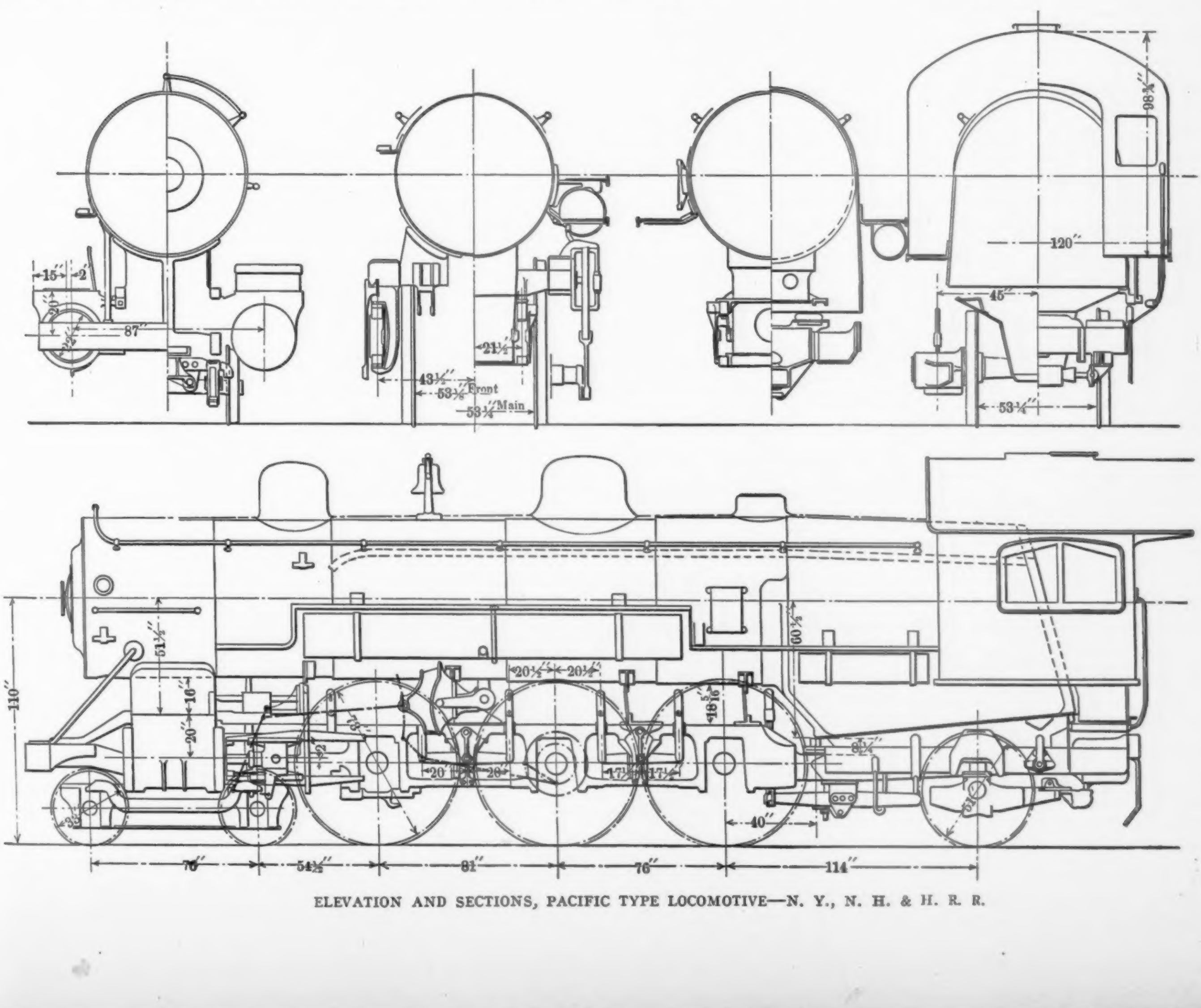


PACIFIC TYPE PASSENGER LOCOMOTIVE—NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

PACIFIC TYPE LOCOMOTIVE.

NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

The motive power on the New York, New Haven & Hartford Railroad, for passenger service, has heretofore included but two types of locomotives, the eight-wheel, or American type, for the lighter class of passenger and suburban trains and the ten-wheel type for the heavier suburban and through express trains. The train schedules of this road demand several trains each day between New York and Boston, a distance of 232 miles, to operate between terminals in five hours. These trains have been handled by a ten-wheel type of locomotive having 21 x 26 in. cylinders, 73 in. drivers and a total weight of 165,950 lbs., of which 132,000 lbs. is on drivers. They have a tractive effort of 26,700 lbs. These engines proved perfectly satisfactory up to the limit of their capacity. This service, however, has become so popular, and since the equipment used is of the most luxurious and modern type, consisting only of heavy Pullman cars, the weight of the trains has become so great as to exceed the steaming capacity of the locomotives. It is not unusual for these trains to consist of 13 or 14 cars, and seldom do they run below 12 cars having a weight of 550 tons. An added car or so has made it impossible for the ten-wheel locomotives to maintain their schedule, largely on account of lack of steam, and a new design of locomotive of the Pacific type has been designed for service on these trains.



ELEVATION AND SECTIONS, PACIFIC TYPE LOCOMOTIVE—N. Y., N. H. & H. R. R.

The Baldwin Locomotive Works has delivered 21 of these engines and the American Locomotive Company 9, all being built from the same drawings. The illustrations which accompany this article are of the Baldwin engines.

The accompanying table will give an opportunity for comparison of the Pacific types with the ten-wheel locomotives in this service and it will be seen that while there has been an increase in the size of the cylinders from 21 x 26 in. to 22 x 28 in., which

Type	4-6-2	4-6-0
Tractive effort, lbs	31,600	26,700
Total weight, lbs	227,000	165,950
Weight on drivers, lbs	134,250	132,000
Cylinders, diameter and stroke, inches	22 × 28	21 × 26
Diameter drivers, inches	73	73
Heating surface, total square feet	3,935	2,665
Grate area, square feet	53.5	34.7
Weight drivers ÷ total heating surface	34.2	49.5
Tractive effort ÷ total heating surface	8.05	10.
Weight drivers ÷ tractive effort	4.25	4.94
Heating surface ÷ grate area	73.5	76.8
Heating surface ÷ cylinder volume	317.	257.
B. D. factor (T. E. × diam. driv. ÷ heat. surf.)	587.	730.

has resulted in an increase of tractive effort of about 5,000 lbs., there has been but little increase in the weight on drivers. The principal change noticed is in the boiler capacity, which has been increased nearly 50 per cent. in heating surface, and over 55 per cent. in grate area, thus giving 34.2 lbs. weight on drivers per sq. ft. of heating surface instead of 49.5, and also giving 1 sq. ft. of heating surface to about 8 lbs. tractive effort instead of 10. An inspection of the B D factor clearly indicates that the capacity of the new locomotives for continuous high speed work is a large improvement over the previous engines.

These locomotives in size and capacity are very similar to those built by the Baldwin Locomotive Works for the Chicago, Burlington & Quincy Railway, which were illustrated on page 300 of the August, 1906, issue of this journal. The Burlington engines, however, have a much larger proportion of their weight on drivers, giving a ratio of 65.5 per cent. of the total weight on drivers, while the New Haven engines give but 59.5 per cent., and although the tractive effort of the former, due to the 1 in. larger drivers, is 500 lbs. less, the ratio of adhesion is 4.8, while that of the New Haven engines is but 4.25. In other respects the two designs differ only in such details as trailer truck, valve gear, valves, etc.

The boiler, which is shown in one of the illustrations, is of the straight top type, the barrel being built up of four rings with the seams placed on the top center line. In the dome course the seam is welded throughout its length on each side of the opening, the other seams being welded only at the ends. All have the diamond form of inside welt strips. The fire box is of the radial stay type with crown and side sheets in one piece, as are also the outside and roof sheets. This type of fire box sheets has been the standard practice on the New Haven road for some time and has been found to be very satisfactory. It is the custom, when it becomes necessary to renew the side sheets, which of course will need renewing before the crown under ordinary circumstancs, to cut the sheet and put the new side sheet in in the same manner as would be done with a three-piece fire box. Four 3-in. water tubes are provided in the fire box for supporting the brick arch. An inspection of the illustration will show that the feed pipes are of the internal type, feeding through a double check valve on the back head to a pipe leading forward to a point near the front tube-sheet, where it is curved downward.

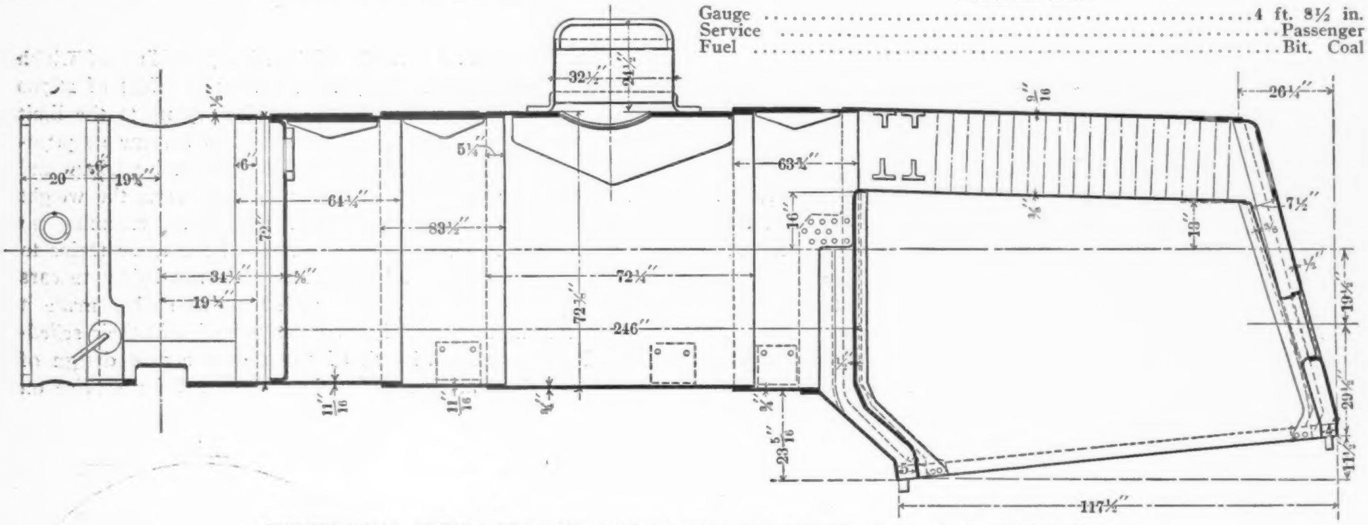
The cylinders are of the usual slide valve pattern, the valves, however, being offset 2 in. outside of the cylinder center to eliminate the use of a rocker arm in the Walschaert valve gear. Cast iron bushings ⅝ in. thick are fitted in the cylinders.

The design of the valve gear differs somewhat from that shown on recent examples of Pacific type locomotives illustrated in these columns, in that the link is supported from an extension of the frame cross tie between the first and second pairs of drivers, much the same as would be done with a consolidation or Prairie type locomotive.

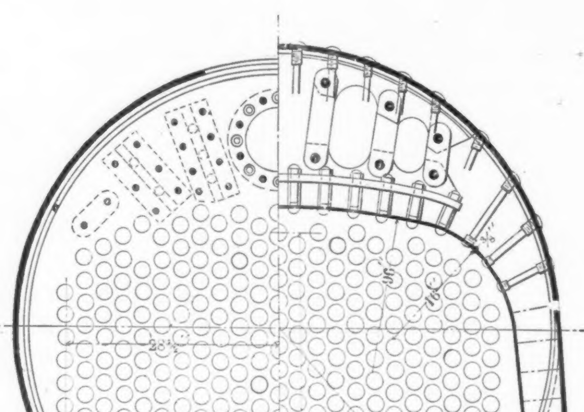
The general dimensions, weights and ratios of these locomotives are as follows:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Passenger
Fuel	Bit. Coal



LONGITUDINAL SECTION OF BOILER, PACIFIC TYPE LOCOMOTIVE—N. Y., N. H. & H. R. R.



CROSS SECTIONS OF PACIFIC TYPE LOCOMOTIVE BOILER.

Tractive effort	31,600 lbs.
Weight in working order	227,000 lbs.
Weight on drivers	134,250 lbs.
Weight on leading truck	48,550 lbs.
Weight on trailing truck	44,200 lbs.
Weight of engine and tender in working order	357,000 lbs.
Wheel base, driving	13 ft. 1 in.
Wheel base, total	33 ft. 5½ in.
Wheel base, engine and tender	61 ft. 2 in.
RATIOS.	
Weight on drivers ÷ tractive effort	4.25
Total weight ÷ tractive effort	7.18
Tractive effort × diam. drivers ÷ heating surface	587.00
Total heating surface ÷ grate area	73.50
Firebox heating surface ÷ total heating surface, per cent	5.45
Weight on drivers ÷ total heating surface	34.20
Total weight ÷ total heating surface	57.80
Volume both cylinders, cu. ft.	12.40
Total heating surface ÷ vol. cylinders	317.00
Grate area ÷ vol. cylinders	4.32
CYLINDERS.	
Kind	Simple
Diameter and stroke	22 × 28 in.
Kind of valves	Bal. Slide
Greatest travel	6⅞ in.
Outside lap	1 3/16 in.
Inside clearance	⅛ in.
Lead, constant	5/16 in.

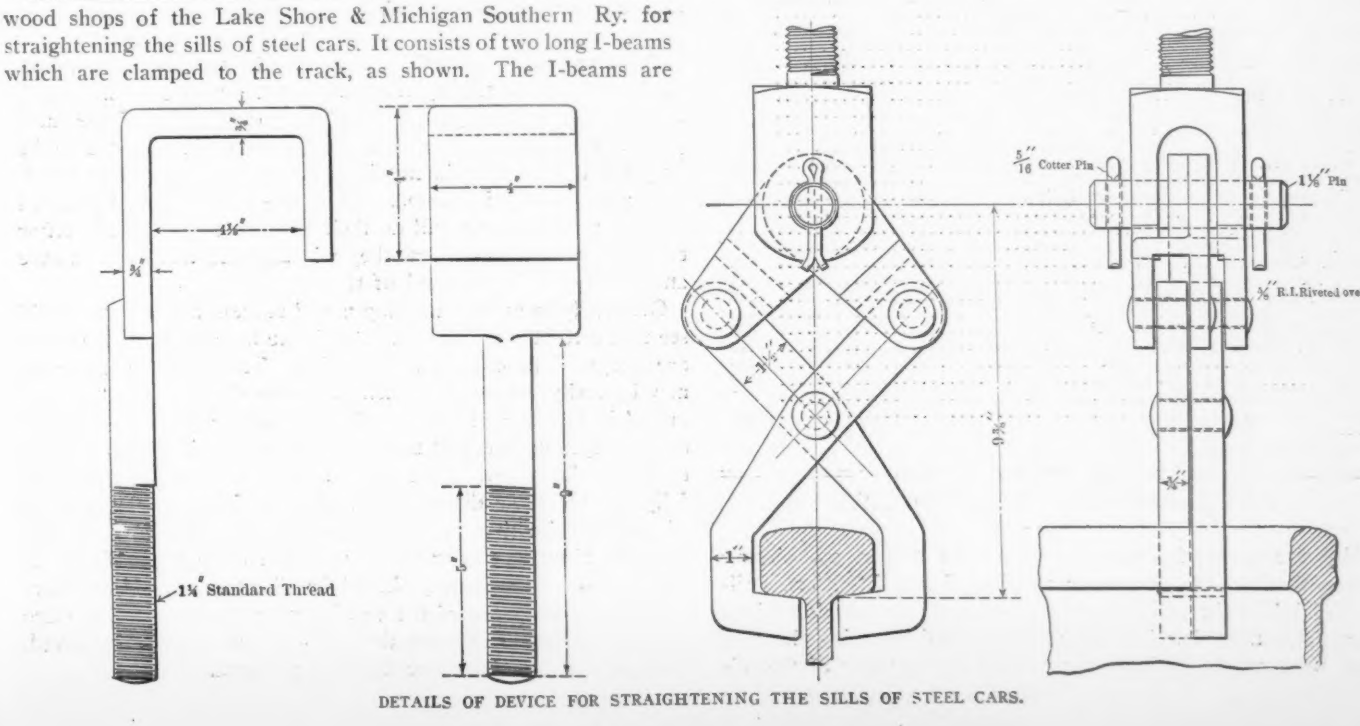
WHEELS.	
Driving, diameter over tires	73 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	10 × 12 in.
Driving journals, others, diameter and length	9½ × 12 in.
Engine truck wheels, diameter	33 in.
Engine truck journals	6 × 12 in.
Trailing truck wheels, diameter	51 in.
Trailing truck, journals	8 × 14 in.
BOILER.	
Style	Straight
Working pressure	200 lbs.
Outside diameter of first ring	70 in.
Firebox, length and width	108⅛ × 71¼ in.
Firebox plates, thickness	⅜ and ½ in.
Firebox, water space	F-5, S & B-4 in.
Tubes, number and outside diameter	310—2¼ in.
Tubes, length	20 ft. 6 in.
Heating surface, tubes	3720 sq. ft.
Heating surface, firebox	186 sq. ft.
Heating surface, water tubes	29 sq. ft.
Heating surface, total	3935 sq. ft.
Grate area	53.5 sq. ft.
TENDER.	
Wheels, diameter	36 in.
Journals, diameter and length	5½ × 10 in.
Water capacity	6000 gals.
Coal capacity	14 tons

STRAIGHTENING THE SIDE SILLS OF A STEEL CAR.

A DEVICE FOR STRAIGHTENING THE SILLS OF STEEL CARS.

The illustrations show a device which is in use at the Collinwood shops of the Lake Shore & Michigan Southern Ry. for straightening the sills of steel cars. It consists of two long I-beams which are clamped to the track, as shown. The I-beams are connected to the hooks which fit over the top of the sill by turnbuckles and clamps, similar to those which hold the I-beam to the rail. By placing a jack underneath the sill, at the proper point, it is an easy matter to straighten it by screwing up the turnbuckles. The device is simple and may easily be moved to any point in the repair yard by two men. There is no reason why it cannot do the work as well as the more complicated devices in use, which are permanently placed, requiring the car to be brought to them.

Powerful Electric Locomotive.—It is reported that a 4,000 h.p. electric locomotive has recently been completed by the Westingnouse Electric & Mfg. Company, which was designed to fill the conditions of the Pennsylvania Railroad for service in its tunnels near New York City. As these tunnels will have very steep grades over which the traffic must be handled at high speed, very powerful machines will be needed. It is not stated whether this locomotive is in more than one section.



DETAILS OF DEVICE FOR STRAIGHTENING THE SILLS OF STEEL CARS.

(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

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BY

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Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to Motive Power Department problems, including the design, construction, maintenance and operation of rolling stock, also of shops and roundhouses and their equipment are desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.*

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CONTENTS

* Illustrated articles.

NET EARNINGS OF A LOCOMOTIVE.

The discussion of Mr. Toltz's paper on "Steam vs. Electric Locomotives" at the September meeting of the New York Railroad Club brought out some very sane comments on this subject, over which there has been so much discussion during the past year. One speaker pointed out that to obtain many of the advantages claimed for electric locomotives there would have to be a big improvement in the operating conditions of through passenger and freight trains. These changes will take considerable time during which there will undoubtedly be improvements in the steam locomotive, making it a more efficient machine. At present the growth of the locomotive has surpassed the extension of other factors in railroad operation and it is probable that it will maintain its lead. Another speaker stated that even if the fabulous figures mentioned in the paper, as a possible saving by the application of several devices to the present locomotive, could be realized it would make no difference in the introduction of electric locomotives. They will be used in certain localities regardless of cost. He brought out the basic truth of the whole matter by saying "that a locomotive is valuable *not* for what it saves but for what it earns above what it costs." If electric locomotives can show greater net earnings they will be used even if their operating expenses are much greater. Also in applying improvements to steam locomotives it is the net results that should be kept in view. It is not sufficent that a device will save 10, 20 or 30 per cent. of the fuel. It must do it without a proportional increase in other expenses. A superheater which will save 15 per cent. of the fuel and water would be of no value if it holds the engine in the roundhouse three or four hours longer than would be otherwise required or if it compels a reduction of tonnage rating, or the cutting out of tonnage on the road. The locomotive must do the work it was designed for first and make what saving it can secondly. While we believe a net saving can be made with superheaters, feed water heaters, variable exhaust nozzles, etc., we do not believe that it will be made by a reduction of the present expense, but rather bv providing a largely increased earning capacity with a proportionally smaller increased operating expense.

RAILROAD CLUBS.

One of the most important functions of our railroad clubs should be to get the younger men interested and to encourage them to take an active part in the work of the club. To attract this class of men, and most of them are working hard to get started and are not overpaid, the financial demands should be kept at a minimum and "full dress" affairs and features of this kind should be discouraged. This holds true also of a large class of capable, ambitious men, such as shop foremen, who ofttimes form the most valuable part of the membership. If the special features are such as to exclude such men, or to impose a hardship upon them, it tends to promote class distinction which should earnestly be guarded against. A railroad club composed of a few of the higher paid officials and a lot of supply-men will not be of any great practical value.

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Some personal work will undoubtedly be required on the part of the officers to stir up the young men and get them started. Much may be accomplished by picking out a few of the most promising ones and personally asking them in advance to be prepared to take part in the discussion of some paper in which they are specially interested. As a rule they will feel honored by such a request and will do their best to "make good." After two or three such occasions they will begin to feel more at ease and much may be expected of them.

Ordinarily to make a meeting a real success the officers should see that certain persons, with an intimate knowledge of the topic, are prepared to open the discussion. This practice, however, may be easily overdone. When the entire discussion is "cut and dried" in advance, and only a favored few have an opportunity of participating, the real usefulness of a club is likely to begin to wane. This does not mean that members should not carefully prepare their discussion in advance, but that the practice of specially inviting too many to take part and formally announcing them, one after another, so that there is practically no time for open discussion, should be discouraged. If members would read the paper of the evening over carefully and prepare their discussion in advance the proceedings could be improved, in some cases, at least one hundred per cent.

The proceedings of the Society of Railway Club Secretaries shows that three railroad clubs have gone out of existence during the past year. The Pacific Coast Club did not survive the San Francisco disaster, the Southern & Southwestern Club and the North-West Club seem to have both lapsed into a state of apathy. All three of these have done splendid work in the past and it is to be sincerely hoped that they will again become active, as nothing can do so much toward getting the railroad men in the various districts acquainted with each other, so that they may interchange ideas and receive inspiration. One club, at least, failed because, although there was a good attendance at the meetings, the work and responsibility of keeping it up seemed to rest on one or two men. Whose fault was this? It behooves the members and officers of each club to study conditions carefully and strengthen up the weak points.

DILWORTH ROUNDHOUSE.

The results of the operation of the new roundhouse on the Northern Pacific Railway at Dilworth, Minn., during the coming winter, will be awaited with great interest. Just as the machine shop is the critical point as concerns output, in most of our railroad shops, so the cinder pit is often the critical point at the roundhouse, and this is especially true during the severe winter weather in the northern part of the country. Entire divisions are often blocked during the colder, stormy weather because of the failure of power, due both to overloading and to inadequate facilities for properly taking care of the locomotives at the terminals. The Northern Pacific is taking "the bull by the horns" and at a considerable expense has installed a roundhouse to relieve the troubles incident to the holding of engines out of doors until their fires can be cleaned at the cinder pit. Radical changes have been made from the ordinary methods of design and these will necessitate equally radical changes in the method of handling the locomotives. The roundhouse is an experiment, but the indications are that it will prove very successful.

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On the average, approximately half of the delay and expense to engines at terminals is in handling them in and out of the house. It is not possible to reduce the time required for repairs to any extent so that any material saving effected must be in the handling. The chief delay in handling is caused by engines arriving at the roundhoue in fleets, and there being only one or two ash pits, it takes a long time to get the last engine in the house. In a cold climate where engines arrive at terminals with ash pans frozen up, it takes considerable time to either thaw or chip the ice out of the pans so that the fires may be knocked out. The firemen are required to bring engines into terminals with good fires and the boiler filled with water, because of the necessity for keeping engines hot while they are waiting their turn at the ash pit. During the time they are waiting, hostlers burn a great deal of coal and use the blower excessively to the injury of the boiler. It very often happens that engines go to the ash pit with a lot of green coal and fresh fire which is knocked into the pit and the coal is thus wasted. While the engines are waiting outside, it is impossible for machinists and boiler makers to get at them for repair work.

In the Dilworth roundhouse, the outside ash pit is not to be used except in emergency. A positive order can be issued which will prohibit having an engine outside the house to exceed thirty minutes after its arrival at the terminal, provided there is a vacant pit in the house for it. As soon as the engine arrives at the terminal, it will be given coal, water and sand and run immediately into the house. If the boiler is to be washed out, the fire will be knocked into the pit at once. If not, the fire will be left in the firebox to die out gradually and when dead the ashes will be knocked into the pit. Keeping the fire in an engine until it dies out will be an advantage to the flues as a more uniform temperature will be maintained in the boiler. It will also generate more or less steam for use in heating the house or heating water for washing out. By allowing the fire to die out in the fireboxes it is thought that there will not be much trouble on account of smoke and gas in the roundhouse. It is estimated that a considerable amount of time will be saved between the arrival at a terminal and the time an engine is ready for departure and that in addition there will be a saving in coal and labor of from $1.00 to $5.00 per engine handled. At this rate of saving the additional cost of the installation would be paid for in a short while.

THE APPRENTICE QUESTION.

The first conference of the apprentice instructors of the New York Central Lines marks the first milestone in the movement for improved apprenticeship conditions on that system. This new system, based on broad, common sense, rational lines, has become well established and while much still remains to be accomplished the splendid progress made thus far, and the strong organization which has been built up, promises well for the future.

The first question which will undoubtedly suggest itself to those who are studying conditions, with a view of establishing a similar organization, will be: Where did the drawing and shop instructors come from? How were they selected? The answer reflects considerable credit on those in charge of the work on the New York Central. In every case the men were selected from the force at the local shops—the drawing instructor being, in most cases, a shop draftsman; the shop instructor a mechanic, who was not only master of his trade and acquainted in a general way with the allied trades, but a man who could understand boys. They are all practical men and some of them have had to study hard to keep up with the school work and yet, to a man, they have been remarkably successful. Is not this a reflection on those companies who are continually going outside of their own organization to find men for special work? Is it because the proper men are not already at hand, or is it because the management is not big enough to find them?

The instructors are urged to think for themselves and not to depend to too great an extent upon the detail instructions laid down by the central organization. Many problems come up which require individual treatment. The instructors are in direct contact with the boys and can see whether the work arranged at headquarters is accomplishing the desired result. They are, therefore, encouraged to criticise and suggest improvements and the following out of such suggestions has added greatly to the success of the work. This freedom of expression on the part of the instructors was especially noticeable at the conference and was undoubtedly responsible for bringing out such a large amount of good, practical information.

We make no apologies for devoting so much space to the apprentice question in this issue. It is one of the most important now before the railroads and industrial concerns of this country and they need all the help they can possibly get to assist them in handling it properly. The proceedings of the conference form a valuable record of the difficulties surmounted during the beginning of the work and suggestions as to future conduct.

* * * * * * *

In establishing an apprentice system two things must be carefully avoided. Do not make the entrance requirements too hard and do not try to cover too much ground in the educational work. Remember that the prime object is to make good mechanics and that the turning out of foremen and higher officials is purely incidental. If you have nothing but high school graduates for apprentices you will gain but very few mechanics, for such men are usually fitted for better positions after they have received their practical training. If you insist on covering too much ground you will discourage and drive out the slower boys, and these are just the ones who will make the future men in the ranks. Good, conscientious work, in encouraging and helping men of this kind to gain a broader view of their work and their place in the organization, and most important of all to teach them to think for themselves, will produce untold future results.

* * * * * * *

The moral training of the apprentices should not be neglected, in fact it should be one of the most important features of the

system. The work which is being done along these lines is clearly brought out in the two papers by Mr. Rausch. The instructor to bring about such results must be a clean, clear cut man morally, with a big heart and a kindly feeling for the boys.

* * * * * * *

Possibly the most interesting part of the conference was the discussion of the practical benefits derived from the school work. The New York Central was not looking for immediate results when it started the new apprentice system. The management was far sighted enough to look five, ten, or fifteen years ahead, feeling sure that they would be amply repaid at that time. Four hours of working time devoted to school work each week by each apprentice amounts to quite an item, but apparently the practical returns already at hand, due to the school work alone, do much to off-set this. In this connection it is important to note that although a shop instructor has not as yet been appointed at the Oswego shops, important practical results are evident, which must be almost entirely due to the school training which the apprentices have received.

* * * * * * *

At the October meeting of the American Society of Mechanical Engineers, Prof. J. P. Jackson of State College, Pa., presented a paper on college and apprentice training. This dealt largely with what on our railroads has been known as special apprenticeship, or the training of the college graduate. Fortunately most of the railroads are doing away with this and the technical graduate is taken into the shop on the same basis as the regular apprentice and his advancement depends entirely upon his ability. The right time for a college man to receive his practical training is previous to or in connection with his college work. The second alternative is a difficult one to fulfil unless the students take things into their own hands and get their practical experience during summer vacations and by taking a year or two off for it, during the college course. The University of Cincinnati has adopted a method by which the students spend alternately two weeks in the class room and two weeks in the works of local manufacturers. Their summer vacations are also spent in the shops. The course is six years long, and without any question it will graduate *real* engineers. The proper relation between the college man and the regular apprentice is clearly brought out in the following extract, which is taken from remarks made by Mr. G. M. Basford in discussing Prof. Jackson's paper.

"It is well to provide for the college man; it is, however, a mistake more serious than most of us can now realize to provide for them unless we have previously put our shop recruiting system for the workmen—the men who do our work—upon a proper basis. I cannot find the words to say, as it ought to be said, that college graduate apprenticeship is wrong from every standpoint unless based upon and preceded by a proper recruiting system and what we generally understand by the term, "regular apprenticeship."

"If we have a proper regular apprenticeship system we have a moral right to deal with college graduate apprenticeship. If we have not such a system, we have no such right and we are making an error for which we shall in time pay dearly. It is easy to realize that this is not a proper sentiment to express, but a warning is evidently needed lest we build our pyramid upon its apex. We stand in need of captains and a few subordinate officers, but we stand in greater need of an intelligent rank and file. In developing the first class let us not kill the second. If we had a good organization as to the rank and file, the captains and subordinate officers would not constitute a problem. *It is from the rank and file that we always have and always will develop leaders. We shall suffer in the long run for any policy which tends in any way to discourage ambition in the large class of men upon whom we must rely.* The best we can do for an industrial organization and for everyone who enters it is to put recruits upon an actual rather than an artificial footing, allowing everyone to make his place in the organization in competition with everybody else. The company already alluded to has for two years made a practice of taking college men in as workmen at a living wage with no promises and no special privileges. The plan is working well and promises well."

A CARD INDEX SYSTEM FOR MOTIVE POWER DEPARTMENT LITERATURE.

To the Editor:

Many readers of your valued periodical are very busy men and can give but very little time toward thoroughly digesting the various articles which are published. Occasions are continually arising, where a remembrance of certain articles is of great value, especially where a similar design or process is contemplated, but unless a thorough index has been provided, under properly classified headings and subheadings, it is difficult to locate what is desired.

The annual index, published in the December number of the American Engineer, is very complete, listing each article under different alphabetical headings, but it is not so easy to locate an article, or series of articles on any subject, as would be the case if the index was made up under classified headings, suitable for a card index system. The writer has evolved such an index, and has frequently found the benefit of it, where discussions as to the practice of other railroads in regard to locomotives or machinery were being held and reference to various illustrations and articles bearing on the question at issue was desired. The saving in time was considerable and the sense of satisfaction at being able to readily locate the desired information was worth all it cost to attain.

From the arrangement of index headings and subheadings herewith submitted, you will notice that each general heading is numbered, and the various subheadings are indicated clearly by letter. This has been done so that a chief draftsman or other official, whose duty it is to care for the technical library of an office, can indicate by marking in pencil, both by number and letter, just under which general heading and subheading, any subject is to be indexed, and can then turn the journal over to a clerk for proper indexing. In order to do this he must have a

CARD INDEX HEADINGS AND SUBHEADINGS.

1—Locomotive Illustrations.
- 0-4-0 Class.
- 0-6-0 "
- 0-8-0 " —etc., following the American Locomotive Company Classification.

2—Locomotive Detail Illustrations and Descriptions.
- a—boilers.
- b—grate riggings.
- c—ash pans.
- d—front end arrangement.
- e—superheaters.
- f—boiler fittings.
- g—frames and details.
- h—running gear.
- i—cylinders and valves.
- j—valve gear.
- k—brakes.
- l—tenders.

3—Articles on Locomotive Design and Details.
- a—detail parts (designing of).
- b—tractive power and steaming capacity.
- c—compound locomotives.
- d—data on fuel (in relation to firebox size).
- e—boilers and boiler maintenance.
- f—cylinders and valves and valve gears.
- g—lubrication.
- h—comparative sizes of locomotives.

4—Articles on Locomotive Operation.
- a—energy and friction.
- b—road tests.
- c—big engines in service.
- d—boiler and flue troubles.
- e—allowances for wear.
- f—fuels, firing and water supply.
- g—train resistance and tonnage rating.
- h—brakes.
- i—cost of repairs.

5—Railway Track Data.

6—Railway Transportation.
- a—overloading and engine failures.
- b—adjusted tonnage rating.
- c—test runs.
- d—train operation and its cost.
- e—railroad statistics.

7—Car Illustrations.

8—Car Detail Data.
- a—wheels.
- b—truck and journal boxes.
- c—draft gear and couplers.
- d—center plates and side bearings.
- e—body details.
- f—brakes and details.

9—Steel Car Data.
- a—steel car illustrations.
- b—steel car development and construction data.

10—Cost Data of Cars.

11—Articles on Machinery.
- a—machinery illustrations.
- b—gas furnaces and gas engines.
- c—oil furnaces.
- d—forging machinery.
- e—hydraulic machinery.
- f—pneumatic tools, hoists, etc.
- g—air compressors.
- h—jigs, chucks, etc.
- i—general shop machinery equipment.

12—Motor Drive Applications.

13—Electrical Data.
- a—power required to drive machinery.
- b—electrical fixtures, etc.
- c—systems of electric driving in shops.
- d—motors and generators.

14—Shop Operations, etc.
- a—shop machinery operation data.
- b—shop processes.
- c—machinery output.
- d—feeds and drives.
- e—operation cost data.
- f—cutting speeds.
- g—lubrication of tools and machinery.

15—Tool Data.
- a—small tools.
- b—tool steels.

16—Shop Organization and Methods.
- a—shop organization.
- b—railroad shop management.
- c—apprenticeship systems.
- d—distribution of work.
- e—piece work, etc.
- f—round house and shop betterment.

17—Shop Layouts, etc.
- a—shop layouts.
- b—round house layouts.

18—Shop Buildings.
- a—shop buildings.
- b—coal and ash conveyors.
- c—ventilation.
- d—heating and lighting systems.
- e—track arrangement—locomotive shops.
- f—shop equipment (cranes, etc.).
- g—fire risks.
- h—oil storage.

19—Power House Data.
- a—illustrations.
- b—steam engine power plant.
- c—gas engine power plant.
- d—terminal yard power plant.
- e—power factors in railroad shops.
- f—motors and generators.

20—General Machinery Data.
- a—working formula for machinery parts.
- b—data on materials of machinery and locomotives.
- c—data on materials of buildings.
- d—data on materials of cars.

21—Miscellaneous Articles, not included in above headings and subdivisions.

copy of the index arrangement before him, since, in some cases, the article will permit of being listed, and should be listed, under several general headings, as provided for by the subheadings.

Following out this system of indexing, in connection with the technical journals, will provide a working library which is always available. Without it more time would be consumed in searching for what is wanted, than could be devoted to it in many cases.

It is hardly necessary to call attention to the fact that, by proper provision on the index card, articles on the same subject from a number of different journals can be indexed, giving an instant possibility of comparison, if desired.

The index arrangement is submitted with the hope that others may find it advantageous to adopt, even though it does mean considerable work to compile it for several volumes at one time, since the advantages will be found to more than offset any labor involved.

Eng'r of Tests, P. & R. Ry. CHAS. A. BINGAMAN.

THE RELATION BETWEEN THE MECHANICAL AND THE STORE DEPARTMENTS.*

BY H. W. JACOBS.

The mechanical department's conception of an ideal store department is one that can fill immediately each and every requisition. To do this, the store department must carry a complete stock, the individual items of which are obtained either in the market or from the shops of the system. To accomplish this the store department must make use of its previous records, determining how much and what stock to carry, and must also be informed by the mechanical department concerning future demands, changes in engine locations and changes in standards. In addition, the mechanical department should have confidence:

(1) That the store department will take care of each and every call for material.

(2) That requisitions will be promptly filled.

(3) That requisitions will be filled correctly.

The stock in hand is the matter of greatest importance in every store house. The aim should be to have a small live stock with as little money as possible tied up and at the same time be able to fill requisitions as presented. The store department might come up to all requirements from the mechanical point of view and yet be inefficient from the standpoint of the owners of the road. Too much stock on hand is almost as much of a waste of money as not enough, not enough meaning loss of money through delays to engines and cars on the repair track, waiting for material to be bought or made, and too much meaning a loss of interest on money invested, deterioration in value on perishable articles, and danger of much of it becoming obsolete and worthless through change of standards.

The railroad that does not carry a full stock of material in the hands of an efficient store department is very short-sighted. I find that if the store department does not carry the necessary amount of stock each gang boss, roundhouse foreman, shop superintendent and master mechanic takes it upon himself to run his own little private store house for his needs, as he sees them. This means an innumerable number of duplications, no records or system and much time wasted hunting for material supposed to exist, but which either never did exist or has been lost. An efficient store department can reduce the quantity of stock by taking complete charge of it, keeping complete records of its location and distributing it geographically to correspond with the class distribution of engines. The mechanical department can further aid the store department to reduce the quantity of stock required, and also the value of it, by standardizing all material to the greatest possible extent.

Standardization reduces quantity. As an example, if of one hundred classes of engines the main rod key is different for each class, the store department must carry at least three hundred keys to protect every engine; if, however, these keys were standardized so that one style of key would do for every engine, then a stock of fifty keys would be ample to protect all of the one hundred classes. Standardization reduces cost, as large quantities of duplicate pieces are ordered at one time and consequently the cost of manufacture per piece can be materially decreased. There is little to be gained in making standard parts unless these parts are to be made in quantities and distributed by an efficient store system.

Standardization also permits of going into the open market for standard parts. This is more the province of the purchasing department than the store department, although the store and mechanical departments are both concerned in the value of their material.

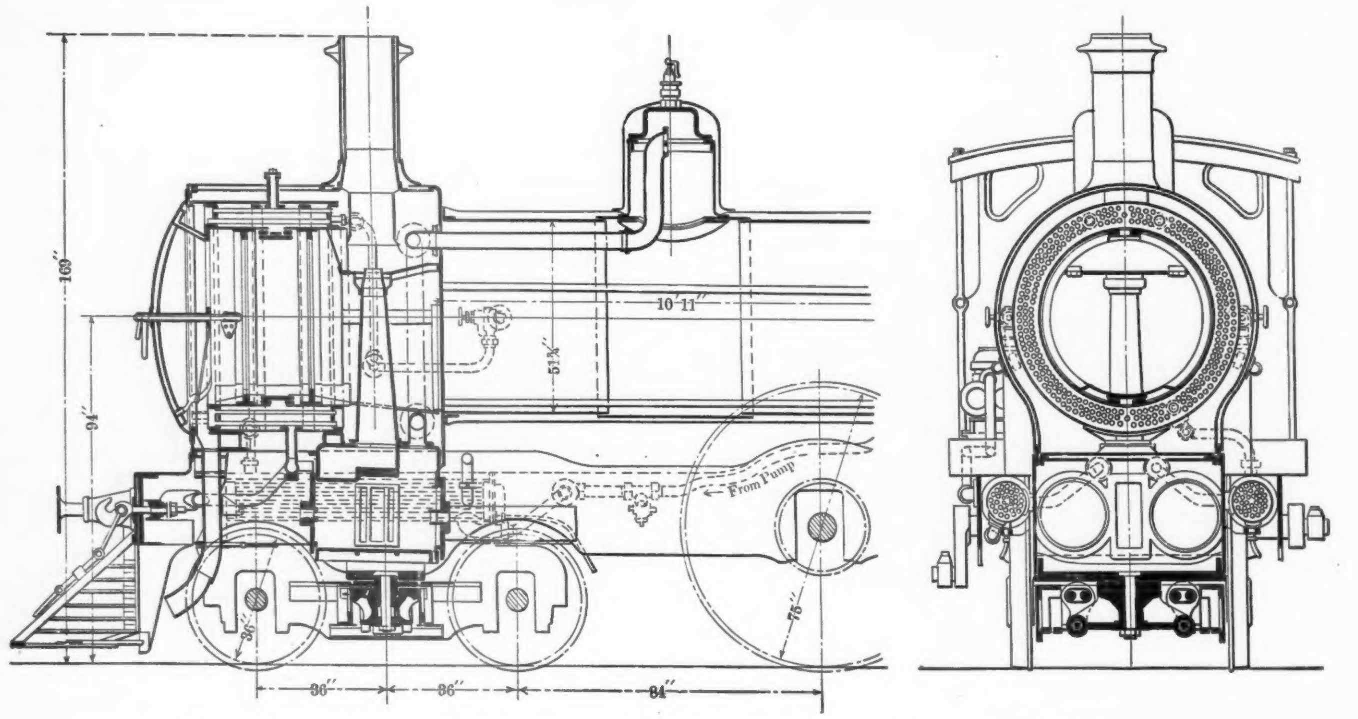
I have said the mechanical department will not order anything unless they need it. This statement should be modified, for unless close watch is kept of the foremen making requisitions they will continually order from two to three times what is needed in their great caution to protect themselves. It is, however, hardly in the province of the store department to dictate as to what the foremen shall order unless they are ordering material which is not standard.

* Extracts from a paper presented before the Railway Storekeepers' Association.

The mechanical department should aid the storehouse to have a competent person pass on all requisitions and see that only the required amount and class of material is ordered. At a certain point, where shops are located, which I have in mind, this official is known as the material supervisor and the results of his work have been a decided decrease in the amount of material ordered for engines being repaired.

I have said that the ideal storehouse should fill every requisition when presented. This means that everything should be carried in stock and all requisitions filled from stock. I would have the store department return to the maker every requisition it cannot fill in three days, or a reasonable length of time, and with the return should be a notice as to when it was expected this material would be in stock.

The maker of the requisition then makes his plans to meet existing conditions. If there is no chance to get the material until some time long after he needs it, he will make arrangements to use something else. If, on the other hand, the material is expected in stock soon enough to meet his needs he will send another requisition, or return the first one at a later date.



TREVITHICK FEED WATER HEATER FITTED TO 4-4-0 TYPE LOCOMOTIVE, EGYPTIAN STATE RAILWAYS.

TREVITHICK FEED WATER HEATER.

There was exhibited at the Milan Exposition an eight-wheel locomotive owned by the Egyptian State Railways, which was equipped with a feed water heater designed by Mr. F. H. Trevithick, locomotive, car and wagon superintendent. This locomotive has cylinders approximately 17¾ x 26 in.; 75 in. drivers and carries 196 lbs. steam pressure. Its total weight is 23,480 lbs.

The accompanying illustration, showing part of the locomotive and feed water heater, as well as the following description of its operation and construction, is taken from the *Revue Generale des Chemin de Fer,* in the August and September issues of which will be found a very complete description of all the locomotives and railway material exhibited at the Exposition.

The feed water is drawn from the tender and forced into the boiler by means of a horizontal duplex pump located on the right side just ahead of the cab. This pump takes steam at boiler pressure and delivers its exhaust into the first section of the feed water heater, which is located on the suction side of the pump. This first heater is vertical and contains nineteen ⅝ in. tubes, which are connected to headers at each end, the upper header being connected to the exhaust pipe from the pump and the lower header having an opening to the atmosphere. The feed water circulates around the outside of the tubes.

On leaving the pump the water traverses in succession two other heaters, one on either side of the smoke box. The one on the right is divided into two compartments by a partition, so that the water traverses twice the length of the heater in passing through. It then goes to the left heater in which there is no dividing partition. These two heaters are heated by part of the exhaust steam from the cylinders. From these the water passes to the larger heater in the front end, which consists of an annular chamber containing 265 tubes 1 in. diameter and 18 in. long, arranged in three concentric rings and heated by the exhaust gases passing through the tubes. The total section of the heater tubes, which is but little larger than the section of the smokestack, is entirely utilized, and their position in reference to the fire tubes assures a perfect separation of the escape gases to the interior of all of them. From this heater the water passes to the boiler through the usual check valves.

Tests which have been made with this heater show that feed water at 68 degs. F. in the tender is heated up to 80 degs. in the first heater, raised to 159 degs. in the second heater, to 193 degs. in the third heater and leaves the smoke box heater at about 270 degs. F. The estimated saving in fuel is about 16 per cent.

A brief description of this feed water heater was given in a paper by Mr. Max Toltz, presented before the New York Railroad Club at the September, 1907, meeting. The description there given was taken from a German paper, and gives somewhat different temperatures in the different sections of the heater. It also states that the saving in coal is over 20 per cent. In discussing this re-heater, the author of the paper suggested that the third section of the heater, where, according to the figures there given, the water is raised from 180 degs. to 230 degs. F., should have trays instead of pipes, upon which all sediment and other matter could be deposited and thus the heater could be made to act as a feed water purifier. It would be necessary in that case to reduce the velocity of flow considerably through this heater in order to give the precipitate a chance to settle upon the trays. These trays could be arranged for easy removal and cleaning.

Block Signals on Union Pacific Railroad.—This road has in operation 496 miles of single and 244 miles of double track equipped with electric automatic block signals.

EXPERIMENTAL ELECTRIC LOCOMOTIVE, PENNSYLVANIA RAILROAD.

ELECTRIC LOCOMOTIVES FOR THE PENNSYLVANIA RAILROAD.

With a view of determining the type best adapted to pulling its heavy passenger trains through the New York tunnels, the Pennsylvania Railroad has in progress a series of experiments upon electric locomotives on its West Jersey and Seashore Division and the Long Island Railroad.

Of the direct current locomotives now undergoing tests, one is equipped with four 350 horse-power geared motors and the other with four gearless motors. The locomotive with gearless motors has one of its trucks equipped with two 320 horse-power motors supported by springs from the main journals and wholly independent of the truck frame, while the other truck has two 300 horse-power motors rigidly fastened to the truck frames. This arrangement will demonstrate the advantages of the two methods of motor suspension under the same conditions of service.

In exterior appearance the two locomotives are almost identical. The trucks are of the four wheel type, having frames placed outside the wheels, with pedestal boxes and adjustable wedges similar to those used in locomotive practice.

On account of their short wheel base the trucks have a tendency to tilt in operation, and thereby shift a portion of the effective load from one pair of wheels to the other. By an ingenious automatic switching mechanism the power delivered by the motor on the heavily loaded axle is increased and the power delivered by the motor on the lightly loaded axles diminished, in proportion to the difference in axle loads. By this expedient the pulling power of the locomotive is said to be increased 25 per cent.

The outer-end casting of each truck carries the coupler, draft spring and buffer arrangement, so that strains caused by pushings, pulling and buffing are taken directly by the truck frames and do not come upon the underframe of the cab, except as they are transmitted between bolsters through the center sill. In order to allow sufficient lateral play when the locomotive is coupled to a long passenger car with considerable overhang, the coupler head has a free movement of 15 inches on either side of the center line of the truck. To facilitate coupling and uncoupling on curves, the coupler can be swung sideways and its uncoupling pin raised by means of levers at the end of the cab, which can be operated from the platform.

The driving wheels are 56 in. in diameter with removable tires secured by retaining rings. They are carried on axles 8 in. in diameter at the center, provided with 6 x 11 in. journals.

The spring rigging is of the locomotive type, with semi-elliptical springs over the journal boxes, and equalizers between the springs. To prevent teetering the equalizer beam is not provided with a fixed fulcrum, but instead supports two nests of helical springs, which in turn help to support the truck frame.

The collector shoes are attached to the four end journal boxes, and are made of two castings forming a spring hinge, with one wing lying in a horizontal plane, and sliding on top of the third rail. The current passes from the third rail through the collector shoes and the heavy cables to the fuse boxes located near the shoes.

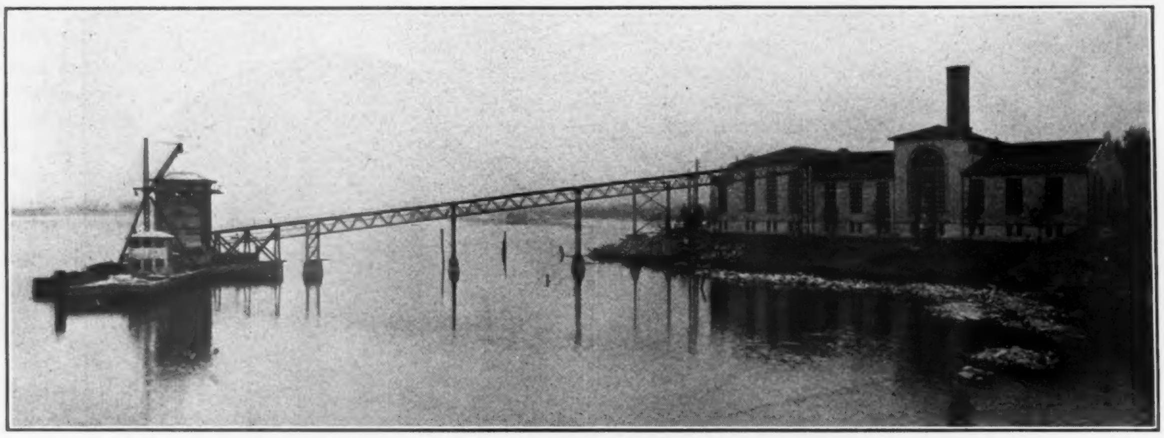
The cab is entirely of metal; its underframe is composed of a center sill, built of two 10-inch channels, side sills of 7 x 3½ in. angles, plate bolsters and end sills. Within the cab the apparatus is distributed along the sides, leaving a passage way through the middle.

The locomotive control mechanism is of the Westinghouse electro-pneumatic type, in which the switches are operated by air pressure. This pressure is controlled by valves actuated by a control magnet on a 14 volt circuit, which circuit in turn is controlled by the master controller. The control mechanism is in duplicate and is placed in diagonally opposite corners of the cab. The current for operating the control magnets is obtained from storage batteries, of which there are two sets, one for use while the other is being charged. These batteries are charged by placing them in series with the motor of the air compressor.

The equipment includes hand, straight air, automatic and high speed brakes and the locomotives have the following general dimensions:

Diameter of driving wheels	56 in.
Axles	8 in.
Journals	6 x 11 in.
Length over couplers	37 ft. 10½ in.
Wheel base of truck	8 ft. 6 in.
Total wheel base	26 ft. 1 in.
Extreme width of cab	10 ft. 1¾ in.
Extreme height	14 ft. 5⅜ in.
Weight (with geared motors)	175,100 lbs.
Weight (with gearless motors)	195,200 lbs.

MASTER CAR BUILDERS' LETTER BALLOT.—Of the 108 recommendations submitted to letter ballot, all but the following six were adopted: No. 15, Brakebeam No. 1; No. 16, Brakebeam No. 2; No. 25, Tests of brake beams; No. 87, Omission of column bolt washers; Nos. 89 and 90, Tank car specifications, including provisions for stenciling light weight and capacity.



VIEW OF COS COB POWER HOUSE SHOWING COAL DOCK AND CONVEYOR.

HEAVY ELECTRIC TRACTION ON THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.*

POWER STATION.

The power house at Cos Cob furnishes single-phase current for the operation of electric trains over the New Haven Road and is also designed to deliver three-phase current to the Port Morris power house of the New York Central to compensate for the energy required to operate the New Haven trains over the lines of the New York Central System.

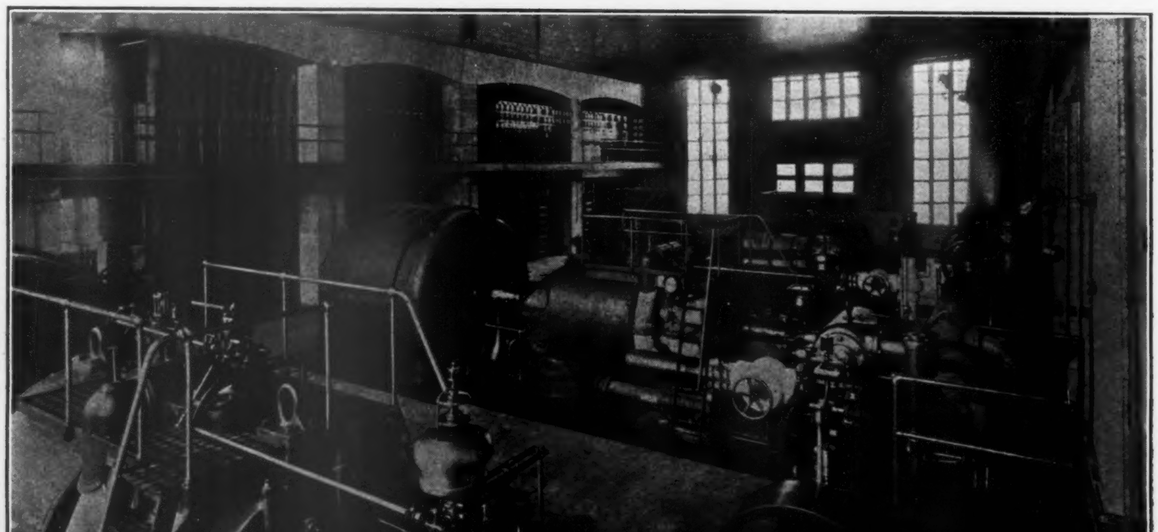
Building.—The power house is located adjacent to the main line of the railroad and on the bank of the Mianus River at a point on the river about one mile from Long Island Sound. The location is such that coal can be delivered either by water or rail, and an unlimited amount of salt water for condensing purposes is available from the Mianus River. By the erection of a dam in this river at a point about a mile up-stream from the power house an abundant supply of exceptionally pure boiler feed water is also readily obtained.

The general style of architecture of the power house building is Spanish Mission; the walls being constructed of plain-faced concrete blocks, the color of which forms a pleasing contrast with the red Spanish tile roof.

The entire area of the site selected was practically solid rock, with but a few inches of earth above it, and necessitated blasting the excavation for the basement and the condenser intake and discharge flumes.

The material excavated was a gneiss rock which proved excellent for concrete aggregate. The building walls, below the water-table, and the machinery foundations are monolithic concrete. The water-table and the walls above it, including the window arches and coping, are of concrete blocks. The interior columns in the boiler room are of structural steel, but all other columns required in the building are of concrete blocks. The steel roof trusses over the turbine room are supported on concrete block pilasters formed in the building walls, while over the boiler room they are carried by the pilastered building walls and by the interior steel columns, which also support the boilers, the mechanical draft equipment and the stack. The front of the switchboard gallery, at the south end of the turbine room, is carried on concrete block columns which also support a reinforced concrete girder forming one of the crane runways. The other crane runway is formed by another reinforced concrete girder built into the partition wall between the turbine room and boiler room, and is supported upon pilasters formed in this wall. The column footings below the turbine room and boiler room floors are of monolithic concrete.

* For general article giving the causes leading to this electrification and the reasons for adopting the single phase alternating current system, see page 362, September issue, and for description of the overhead structure and electric locomotives see page 396, October issue of this Journal.



VIEW IN TURBINE ROOM, COS COB POWER HOUSE—NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

The basement floor is of concrete, laid upon the foundation rock. All other floors in the building are of reinforced concrete; and the roof, which has a pitch of 4½ in. per foot, is of reinforced cinder concrete finished on the exterior with Ludowici tile.

A monitor, provided with windows for light and ventilation, extends lengthwise over the boiler room.

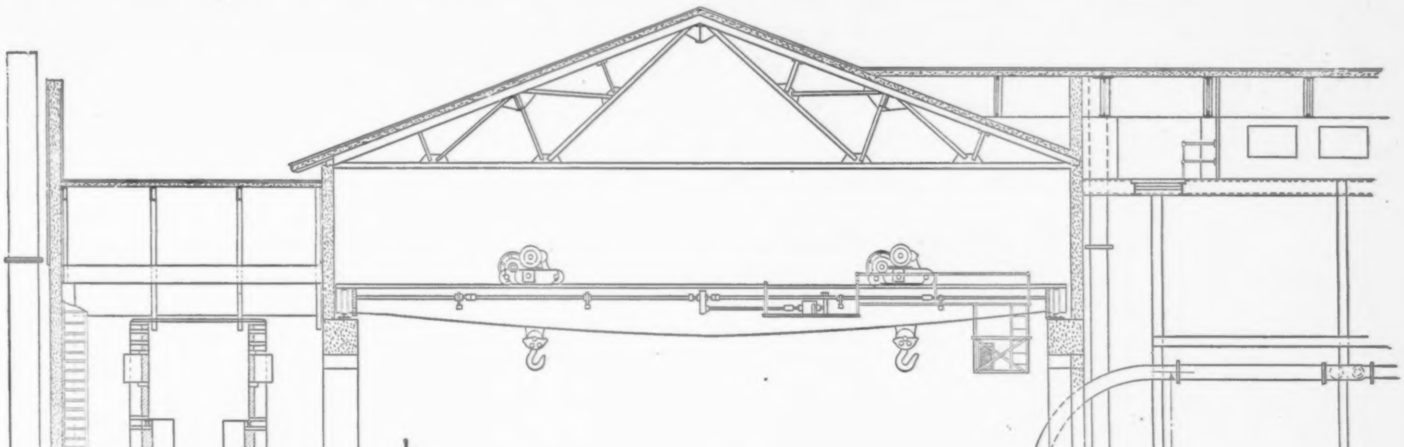
A self-supporting steel stack 13 ft. 6 in. in diameter extending to a height of 100 ft. from the boiler room floor, is carried by the steel columns which support the fan room floor, leaving the space below, on the boiler room floor, entirely clear.

The building is exceptionally well lighted by large windows glazed with wire glass set in cast iron sash.

flow Parsons steam turbines direct-connected to single-phase Westinghouse generators. Provision has been made for the installation of a fourth unit of corresponding size. The turbines are rated at 4,500 brake horse-power each and the generators at 3,000 kw. each, at 80 per cent. power factor.

As the requirements necessitated the generation of three-phase current for delivery to the New York Central system as well as single-phase current for the operation of the electric locomotives over the New Haven Railroad, the generators are wound for three-phase current but arranged for the delivery of both three-phase and single-phase current.

The turbines are operated at 1,500 revolutions per minute by steam at 200 lbs. pressure and 100 deg. superheat. The continu-



SECTION THROUGH TURBINE ROOM, COS COB POWER HOUSE—N. Y., N. H. & H. R. R.

The turbine room is 60 ft. wide by 112 ft. long, and the switchboard occupies a space, next to the turbine room, which is 25 ft. wide by 110 ft. long. The boiler room is 160 ft. long and 110 ft. wide.

The reduced head room needed for horizontal turbine equipment is shown by the fact that the distance from the floor to the top of the crane runway rail is but 27 ft. 2 inches, and the height from the turbine room floor to the bottom of the roof trusses is but 39 ft. 2 inches. The interior walls of the turbine room are finished with a wainscoting of Faience tile six feet in height.

Turbo-Generators.—The initial generating equipment of the power house consists of the three multiple expansion parallel

ous overload capacity of the units is 50 per cent., and momentary overloads of 100 per cent. can be taken care of when operating condensing.

The turbines are equipped with the latest accessories in the way of automatic safety stops, water packed glands for the turbine shaft, and adjustable water-cooled bearings equipped with a continuous circulation oiling system.

The generators are entirely enclosed by a casing into which air is drawn through suitable ducts from a fresh air chamber under the switchboard gallery, and from which the air is discharged through other ducts into the basement. This system of generator ventilation renders the operation of the generators practically noiseless.

The excitation of the generator fields is provided for by two 125 kw. direct current generators, direct connected to Westinghouse engines; and one motor driven exciter.

Condensers.—A separate condensing outfit is provided for each turbine consisting of an Alberger three-phase counter-current surface condenser, a two-stage dry air pump, a centrifugal circulating pump direct-connected to a Westinghouse engine, and a Monitor hot well pump, the speed of which is automatically controlled by a float.

Condensing water for all the condensers is furnished by a single flume which is constructed of timber having a lining of creosoted lumber, from the intake at the face of the dock to the shore line, and of concrete for the remainder of its length to and under the generator room. A discharge flume of similar construction parallels the intake flume under the turbine room, and then diverging from it discharges the condensing water into the river. Each condenser is installed directly beneath the corresponding turbine, and over the discharge flume, while the circulating pumps are located over the intake flume, thus making all the connections as short as possible.

The pipes leading from the condenser to the discharge flume have a submerged discharge, thus decreasing the head under which the circulating pumps work.

To prevent the rapid deterioration of the brass condenser tubes by the galvanic action which usually occurs where salt water is employed for condensing purposes and which is often aggravated by stray currents passing through tne water pipes into the station and from thence to the condensers and out through the pipes leading into the intake and discharge flumes, a motor generator set has been installed and provided with suitable controlling apparatus for maintaining in each condenser a counter electromotive force slightly in excess of the electromotive force due to the galvanic action and the stray currents.

Boilers.—The initial installation consists of 12 525 h.p. Babcock & Wilcox water-tube boilers set in batteries of two boilers each, and arranged with 8 boilers on one side and 4 boilers on the other side of the boiler room, separated by a 21 ft. firing floor. Provision is made for 4 additional boilers to take care of the fourth turbo-generator unit when it is installed. These boilers are equipped with Roney mechanical stockers and Babcock & Wilcox superheaters and deliver steam at 200 pounds gauge pressure and 125 deg. superheat.

A novel feature of the boiler settings is the installation of an external steel casing entirely enclosing the brickwork, thus rendering the settings impervious to air leaks.

Economizers.—Three Green fuel economizers are provided and the boiler flues leading to the economizers are arranged with by-passes so that one or all of the economizers can be cut out, and the flue gases from either two or four batteries may be passed through either one of two of the economizers, thus adapting the economizer installation to the changing demand upon the boilers.

The economizers are enclosed by means of metal sectional covering insulated with prepared asbestos blocks.

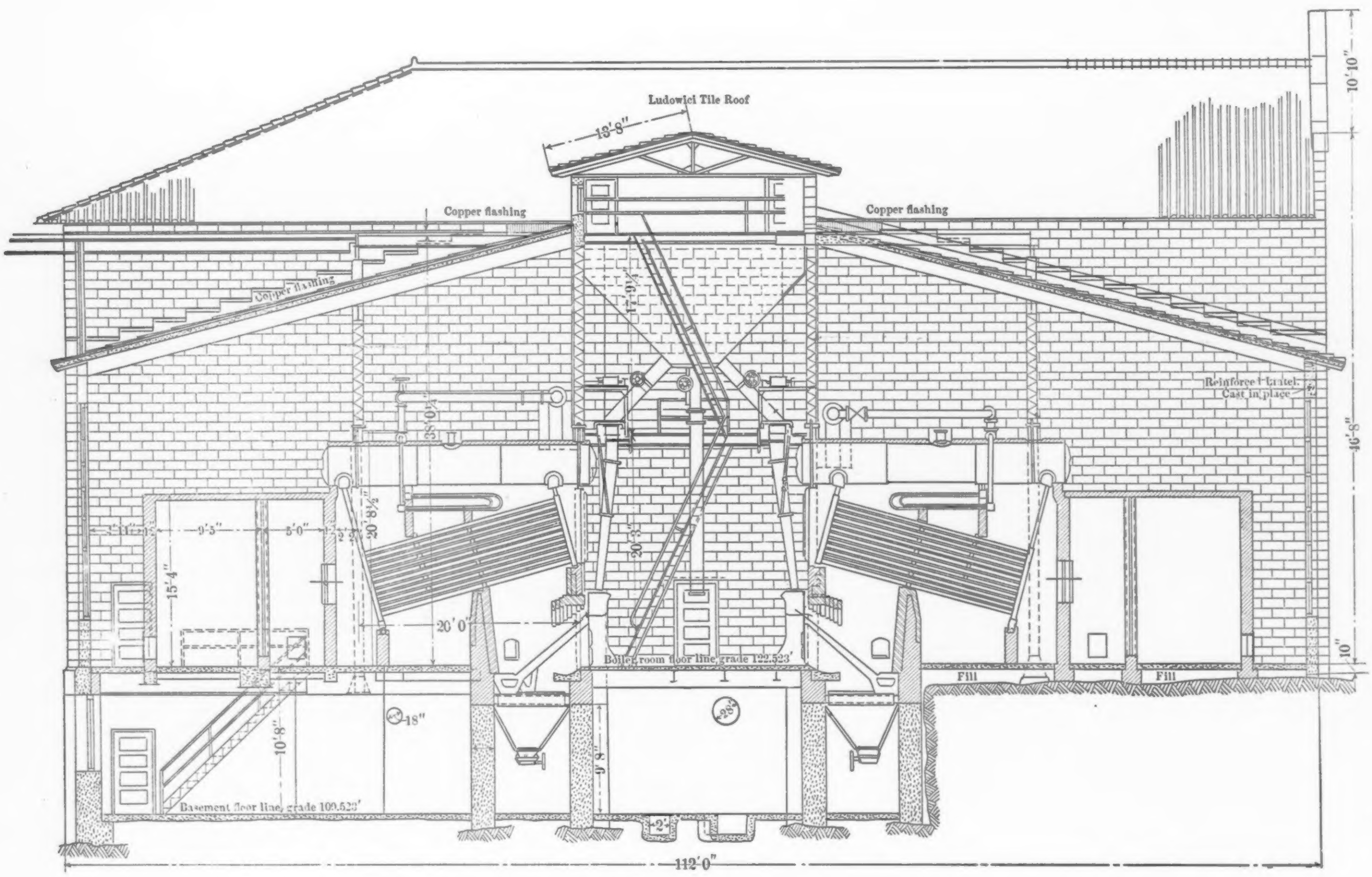
Feed Water System.—Under ordinary conditions the boiler feed water is delivered from the pump house at Mianus through a 10-inch main to a concrete reservoir of 600,000 gallons capacity situated just outside the power house. From this reservoir the make-up water flows by gravity to two 13,000-gallon feed water tanks located in the boiler room basement. These tanks also receive the discharge from the hot well pumps. The water is then drawn from these tanks by the feed pumps and delivered through the feed water heaters and the economizers into the boilers.

An auxiliary source of feed water supply is provided by a connection to the mains of the Greenwich Water Co.

The feed pumps, three in number, are of the compound, direct connected, duplex, outside packed, plunger type.

Provision is made for connecting either source of feed water supply direct to the suction side of the feed water pumps, and also for by-passing the feed water heater or the economizers. An emergency feed water supply system is also provided, consisting of two Hancock inspirators, taking water from either source of supply and delivering it through an independent line to the boilers.

The pumping equipment at Mianus comprises two single act-



SECTION THROUGH BOILER ROOM, COS COB POWER HOUSE—N. Y., N. H. & H. R. R.

ing vertical triplex plunger pumps, geared to Westinghouse three-phase motors. One of these is of sufficient capacity to meet the requirements of the plant running non-condensing, and the other, to supply all the fresh water needed when running condensing. These pumps are operated by current obtained from the power house.

Induced Draft System.—After leaving the economizers, the flue gases pass through sheet iron flues to the fan chamber over the center of the boiler room. Here, four 14 ft. fans, direct connected to horizontal high speed engines, deliver the flue gases to the stack, which is only of sufficient height to carry the gases away from the building. The speed of the fans is adjusted to the demand on the boiler by automatic regulating valves controlling the fan engines.

Coal Handling.—All coal received by water is unloaded from the barges by a steel derrick operating a clam shell bucket and is delivered into a hopper of fifteen tons capacity at a height of 55 ft. above the dock. This bucket is operated by an engine on the dock, supplied with steam from the power house. From this hopper the coal is fed by gravity into a coal crusher and from the crusher it drops into steel cars where it is weighed. The cars are then drawn by cable up an inclined single-track railway of 13 per cent. grade and into the boiler room through an opening near the roof. This track is supported upon structural steel towers, and is designed so that two cars can be operated upon it, passing each other through an automatic turnout at the center. The cars discharge the coal into a hopper, from which it is delivered into two flight conveyors, extending the length of the boiler room. Openings in the bottom of the flight conveyors discharge the coal into sprouts leading to the stoker hoppers of the boilers. The capacity of the flight conveyors is in excess of the amount of coal required to operate the boilers, and the surplus coal is discharged at the further end of the boiler room into a concrete storage bin below the boiler room floor.

Coal received by rail is dumped from the car directly into a chute leading to this same storage bin. When the boilers are to be supplied from this source the coal is discharged from the bin by gravity into a coal crusher, and from thence into a bucket conveyor located in a tunnel underneath the bin, by which it is delivered to the flight conveyors above the boilers, and thence through the chutes to the stoker hoppers.

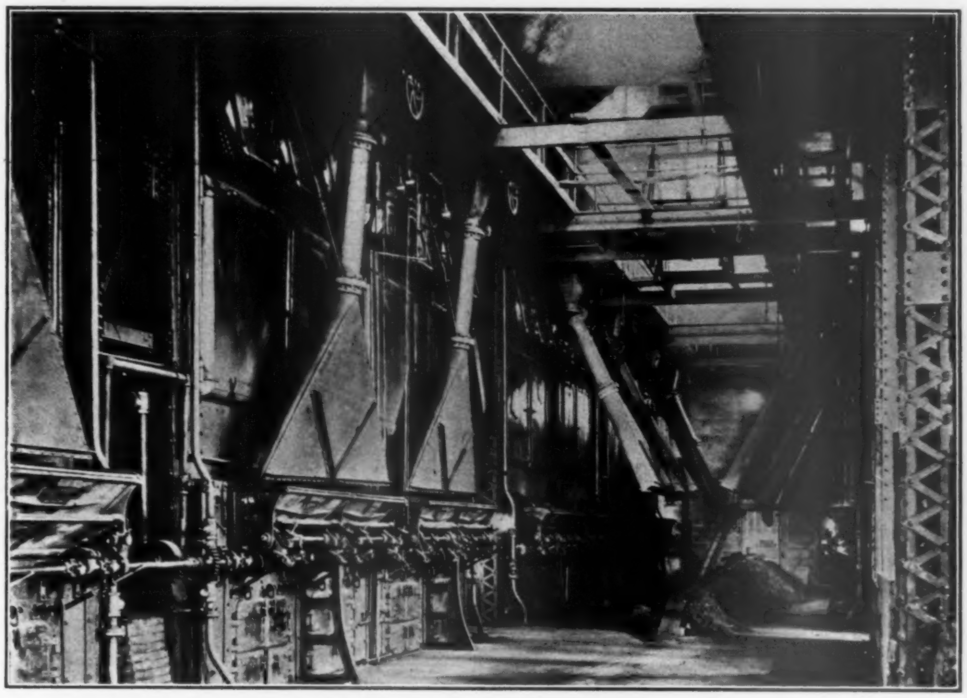
The cable railway and the flight and bucket conveyor are operated by three-phase induction motors, taking current from the "Station Service" line.

The ashes are disposed of by gravity from the dumping grates of the stokers into chutes leading to narrow-gauge cars in the basement, by which they are at present carried to the low ground in the neighborhood of the power house, and used for filling.

Piping.—A steam main is carried over the boilers on each side of the boiler house, each of the two mains crossing over to the opposite side at the center of the boiler room. Provision is made for cross-connecting these two mains. From the boiler room the mains extend through the partition wall into the turbine room, thence downward into the basement connecting to a header under the floor. From this header connections are made to each turbine. In addition to the throttle valves and the automatic stop valves, shut-off valves are provided for each turbine under the boiler room floor. These valves are controlled by hand-wheels mounted on stands in the turbine room. A separate steam main is provided for the steam driven auxiliaries, which are all designed to use superheated steam. Steel pipe, with extra-heavy welded flanged joints, is used for all high pressure steam lines, contraction and expansion being provided for by the use of long radius bends.

An exhaust line leads from each turbine directly down to its condenser and is connected by an automatic relief valve to an individual outboard exhaust line, which passes through the turbine room basement to the outside of the building and thence to a point above the roof.

The piping from the pumps to the feed water heaters and economizers is of cast iron, while that from the economizers to the boilers, with the exception of a cast iron header below the floor, is of brass.



INTERIOR OF BOILER ROOM, COS COB POWER HOUSE.

A closed feed water heater containing 2,000 sq. ft. of surface and utilizing the exhaust from the steam driven auxiliaries is provided.

Oiling System.—A continuous circulation oiling system for the turbine and generator bearings is installed. The oil is elevated by a small steam pump into a tank situated in the fan room and flows from this tank by gravity to the various bearings. After passing through the bearings, it is discharged into a filter, from which the filtered oil passes to a receiving tank in the turbine room basement, to which the suction of the oil pump is connected.

Taps are placed in this line at convenient points for filling the oil cups on the auxiliary engines and pumps.

Electrical Distribution.—The main cables from each generator are run in the air chamber under the turbine room floor, up to the switchboard gallery and thence through selector oil circuit breakers down to the high tension buses under the switchboard

gallery. These circuit brakers are electrically interlocked so that the buses cannot be paralleled.

The two high tension buses, with their accompanying switching equipment are interchangeable and are arranged so that each can be used separately: one suppling three-phase current to the Port Morris feeders, and the other supplying principally single-phase current for propulsion. Each bus is further divided by knife switches into three sections; each end section containing generator leads and propulsion feeders, and the center section containing the Port Morris feeders, so that in an emergency a still further subdivision can be effected.

When a bus section, or the entire bus, is used for supplying single-phase propulsion current, one leg is grounded directly to the track rails of the right of way through suitable switches; another leg supplies the outgoing feeders, which are run in duplicate, connecting directly to the trolley and which forms the complete single-phase circuit; the third leg of this bus is also connected to a feeder which is carried along the right of way for the purpose of supplying power for local purposes, and completing the three-phase circuit along the line.

Each leg of the high tension bus, consisting of two 3 in. x 1/4 in. copper bars, is enclosed in a separate masonry compartment composed of pressed brick and soapstone and is supported on porcelain pillars and bushings projecting from the side wall of the compartment, the bushings providing for cable connections

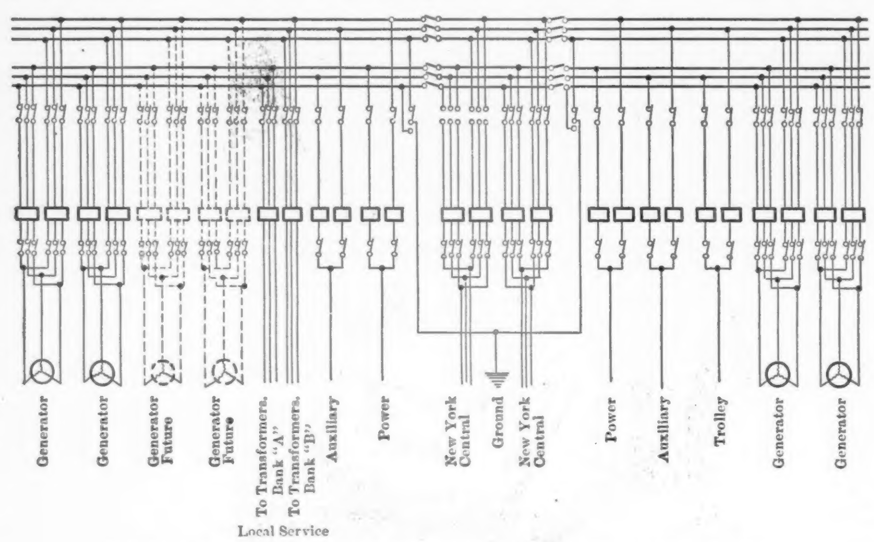


DIAGRAM OF HIGH TENSION CONNECTIONS, COS COB POWER HOUSE.

to the bus. Removable glass doors are provided in the bus compartments at small openings opposite all connections and supports. The connections between the bus bars and the circuit breakers consist of insulated cable and are carried up in separate brick septums on the back of the bus bar and oil circuit breaker structure. Each oil circuit breaker can be disconnected from the bus and circuit by hook type knife switches located on the rear of the structure.

The feeder cables pass along the top of the circuit breaker structure, thence to choke coils in the arrester gallery and through special windows, to the line. Each feeder is protected by a lightning arrester of the Westinghouse Electric & Mfg. Co.'s low equivalent type, with fuses.

For normal operation of this station one set of buses will supply the three-phase feeders leading to Port Morris, and the other set the single-phase propulsion feeders and the local three-phase circuits.

The voltage of each high tension bus is maintained constant by a Tirrill regulator, controlling the exciter field circuits.

Switchboard.—The main switchboard is made up of marble slabs carrying Westinghouse instruments and switching apparatus. It contains four panels for the operation of the generators, three panels for the control of the exciters, two panels for the Tirrill regulators, one load panel, one inclined station panel for the synchroscope, and A. C. voltmeters, and five panels for the apparatus controlling the outgoing feeder system and the local high tension circuits.

Each generator panel is equipped with instruments indicating the current per phase, the power factor, the indicated watts, and the field current. Receptables are also provided on each generator panel for making connections with the synchroscope and the voltmeters on the inclined panel. This panel contains the main field switch and rheostat handwheel, together with an electric governor controller for changing the speed of the generators from the switchboard gallery for the purpose of synchronizing, when it is desired to throw two or more generators in parallel. The oil circuit breakers between the generator and the buses are also electrically controlled from these panels. Totalizing wattmeters are placed in the bus sections in such a way as to register the total load of the generators or of any group of feeders.

Each feeder is equipped with an ammeter, overload relay and controllers for its oil circuit breakers. Colored lights on the switchboard indicate the position of the circuit breakers.

For supplying power to the various motors throughout the station, duplicate sets of two transformers each are used. They are "T" connected and supply three-phase current at 440 volts.

For the control of the station circuits, a local service switchboard is installed.

THE VALUE OF A BRICK ARCH.

A paper which was presented by Mr. G. W. Bennett before the recent convention of the International Master Boiler Makers' Association gave the results of some tests which were made on a wide firebox engine to ascertain the efficiency of the brick arch and arch tubes.

The boiler of this locomotive had a firebox 105 in. long and 75 1/4 in. wide. It contained 458 2-in. tubes 15 ft. 6 in. long and carried a steam pressure of 200 lbs. The firebox was equipped with four 3-in. water tubes for supporting the arch. The test showed that with the brick arch and water tubes in place the equivalent evaporation per dry pound of coal showed an increase of 14.9 per cent. over that obtained without the arch or tubes. There was a gain of 9.3 per cent. with the arrangement with the water tubes, but without the arch in service. The coal fired per sq. ft. of grate area per hour showed a decrease of 14.7 per cent. and 7.8 per cent. under the same conditions.

The tests were very carefully made and the boiler pressure was maintained constant. Six runs were made in each case, three with a partially closed throttle and three with a wide open throttle. The results given are an average of all the runs.

TEST OF 7500 K. W. STEAM TURBINE.

An eight-hour economy test was made, September 1, on a 7,500 k. w. Westinghouse-Parsons steam turbine at the Waterside Station of the New York Edison Company. The turbine unit is of the standard Westinghouse construction throughout and has a maximum rated capacity of 11,250 k. w. It was built to operate on 175 lbs. steam pressure, 28 in. vacuum and 100° superheat. Under these conditions the turbine was guaranteed to have a minimum steam consumption of 15.9 lbs. per k. w. hour with a normal speed of 750 r. p. m. The electrical efficiency of the generator was guaranteed to be 97.8 per cent., exclusive of friction and windage.

The results of the tests, calculated for the conditions as actually run, were as follows:

Duration of test	8 hours
Average steam pressure at throttle	177.5 lbs.
Average superheat at throttle	95.74 degrees
Average vacuum	27.31 in.
Average load on generator	9,830.48 k. w.
Average steam consumption	15.15 lbs.

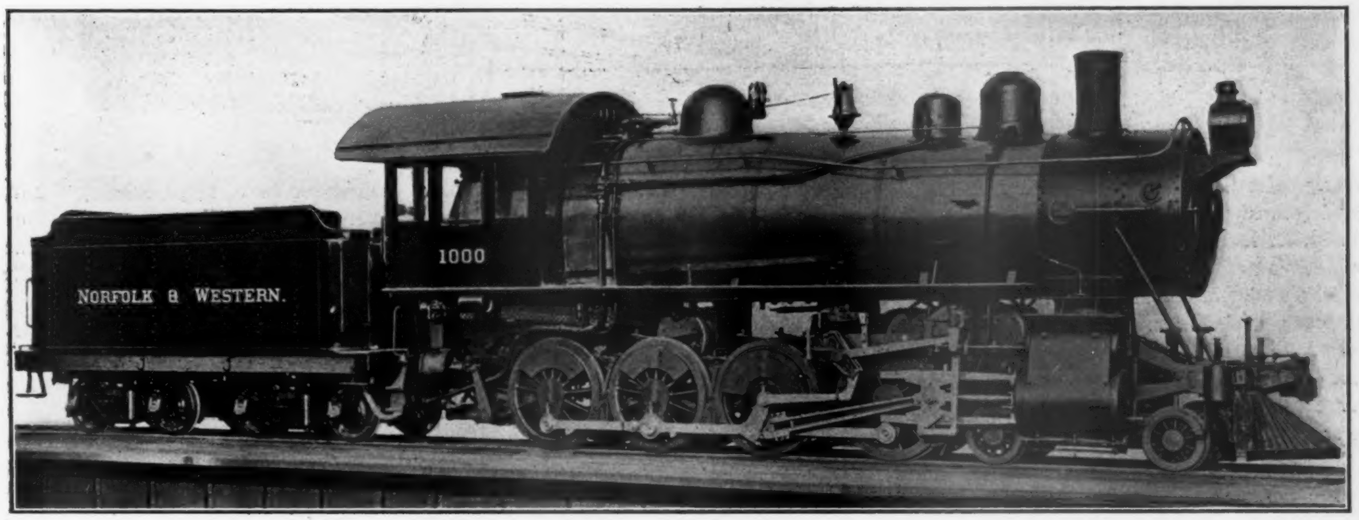
It will be noted that the conditions under which the tests were run were somewhat different from those under which the guarantee was made, and when corrections are made for these differences it shows that the water rate for the turbine was 14.85 lbs. per k. w. hour, or 1.05 lbs. less than the guaranteed rate.

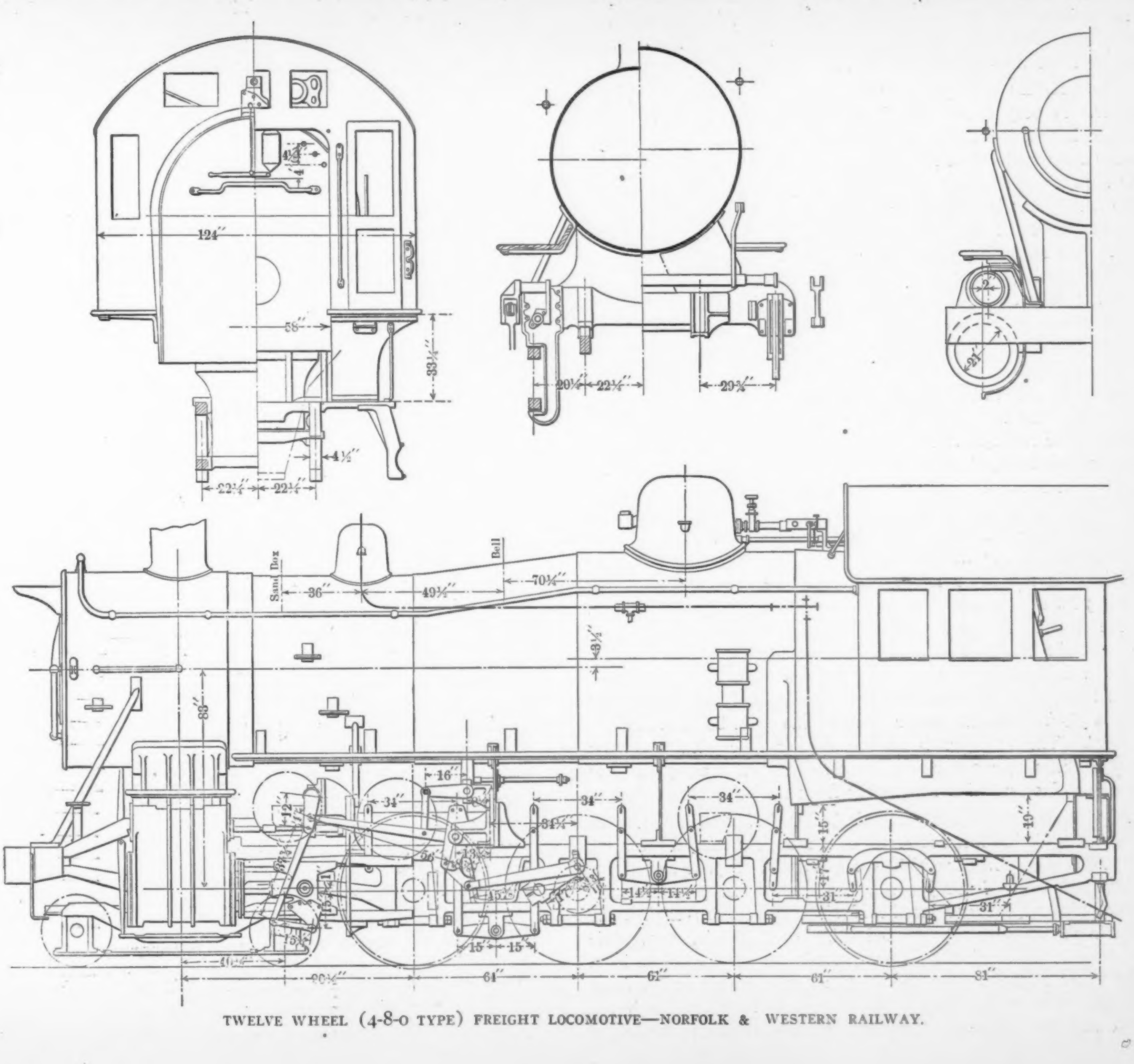
TWELVE-WHEEL FREIGHT LOCOMOTIVE.

NORFOLK & WESTERN RAILWAY.

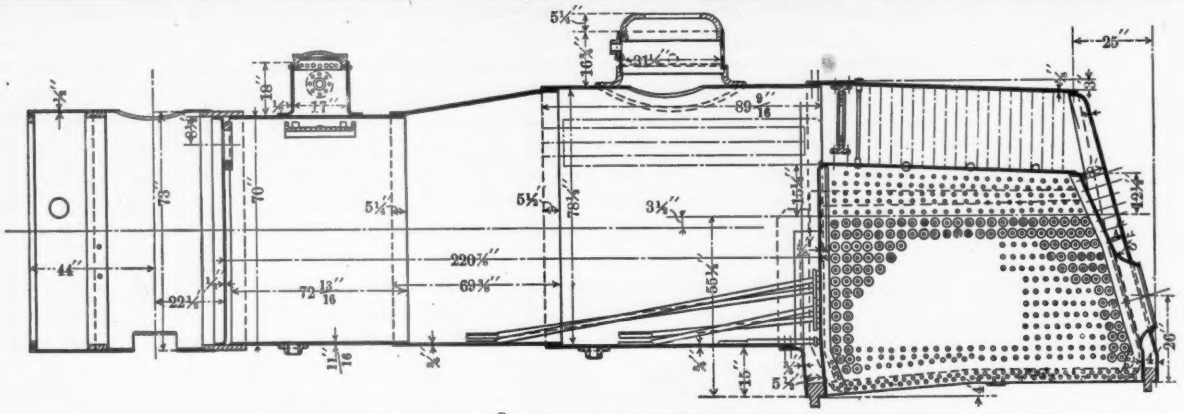
The Baldwin Locomotive Works has recently delivered fifty 4-8-0 type locomotives to the Norfolk & Western Railway, which are in general very similar to an order built last year for the same road. The most important change made in the design is the substitution of the Walschaert for the Stephenson valve gear. The principal details, aside from the valve motion, were constructed from the railroad company's drawings.

The total weight of the locomotives is 204,050 lbs., of which 165,850 lbs., or 81 per cent., is on drivers. The average proportion of weight on drivers for a consolidation type of locomotive is 89 per cent. The tractive effort is 40,200 lbs., giving a ratio of adhesion of 4.13 and a ratio to the total weight of 5.09. A consolidation locomotive with practically the same total weight and the same factor of adhesion would give a tractive effort of





TWELVE WHEEL (4-8-0 TYPE) FREIGHT LOCOMOTIVE—NORFOLK & WESTERN RAILWAY.



LONGITUDINAL SECTION OF BOILER, 4-8-0 TYPE LOCOMOTIVE—NORFOLK AND WESTERN RAILWAY.

nearly 44,000 lbs., which indicates the big advantage to a railroad company of having a line suitable for the operation of consolidation locomotives. The weight per axle of these 12-wheel engines is nearly 41,500 lbs., and a consolidation of the same total weight would be about 45,400 lbs. In comparing the two types, however, it should not be forgotten that the 12-wheel type permits a longer boiler and hence longer flues, and allows the same amount of heating surface to be obtained with a smaller number of flues and wider bridges. This point will be mentioned later.

The locomotives are arranged with a continuous driving equalization on each side and the second pair of wheels, being the main drivers, are fitted with plain tires. The others are flanged. The main wheels have cast steel centers and the others steeled cast iron. The main frames are of cast steel 4½ in. wide with double front rails of wrought iron.

The cylinders are equipped with 12 in. inside admission piston valves. A very compact design of valve motion has been arranged in which the links are carried on an extension from the frame cross tie back of the first pair of drivers. The links are of the built up type with cast steel side plates and double trunnions. The lifting link is connected to the radius bar ahead of the link, the reverse shaft resting in bearings almost directly above the link. The center line of the valves is 2 in. inside the center line of the cylinders, which makes a rocker arm necessary. Advantage has been taken of the clear space between the frames, due to the design of the valve gear by the installing of three large air drums, arranged as shown in the illustration.

The boiler, which is the most interesting feature of this design, is of the extended wagon top type and carries 200 lbs. pressure. The longitudinal seams are welded for 9 in. at each end and are sextuple riveted with double welt strips. The crown sheet is radial stayed, with one T iron at the front end. A liberal use has been made of flexible stay bolts throughout the breakage zone. The arrangement of these will be seen in the boiler drawing. The back flue sheet is unusually well braced, as is also shown in the illustration. Very liberal spacing has been provided in the water legs around the fire box, the mud ring being 5 in. wide at the sides, the space being increased to 7¾ in. at the crown. The back mud ring is 4 in. wide and the distance between the crown sheet and back head is 8 in. The fire door opening is formed by flanging both sheets outward, the inner sheet being given an easy bend at a large radius. The front mud ring is 5½ in. wide, the water space at this point being practically vertical. The ash pan is of the hopper type with cast iron bottom slides operated by an air cylinder. It is equipped with sprinkler pipes supplied with water from the injector overflow.

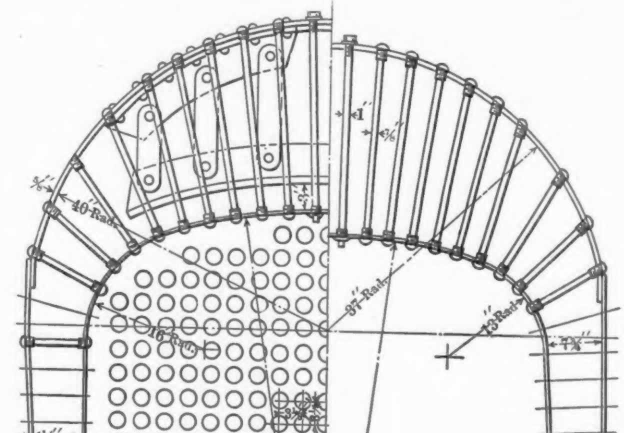
It is interesting to compare this boiler design with that used on a consolidation locomotive built by the same company for the Pennsylvania Railroad, which was illustrated on page 231 of the June, 1906, issue of this Journal. That boiler has practically the same ratios as the one on the Norfolk & Western engine, the flues in the former, however, being but 13 ft. 8½ in. long, while the flues of the Norfolk & Western engine are 18 ft. 4⅞ in. long. The boiler in the former case is 71 in. in diameter at the front end and 70 in. in the latter. The heating surfaces are nearly the same and the difference in the two designs comes altogether in the number, spacing and size of the flues, there being 373 2-in. flues in the Pennsylvania boiler and 242 2¼-in. flues in the Norfolk & Western. The latter engine has but 26 per cent. of the area of the boiler at the front end taken up by flues, while the former has 31 per cent. This illustrates that the 12-wheel design has an advantage in permitting the same amount of heating surface with a much more open arrangement of flues and wider bridges. The flues in this case are arranged in vertical and horizontal rows and have ⅞ in. bridges.

The feed water on these locomotives is discharged from the check valves into a small dome built of ½ in. plates and located on the first ring of the boiler barrel. Water enters the boiler from this dome through sixty-one 1 in. holes drilled through the shell and strikes a deflector plate which delivers it on either side of the dry pipe. The feed dome is practically filled with a series of horizontal baffle plates placed one above the other on which is deposited a large part of the impurities in the feed water. These plates can easily be removed when necessary and replaced with clean ones.

The general dimensions, weights and ratios are as follows:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Freight
Fuel	Bit. Coal
Tractive effort	40,200 lbs.
Weight in working order	204,050 lbs.
Weight on drivers	165,850 lbs.
Weight on leading truck	38,200 lbs.
Weight of engine and tender in working order	320,000 lbs.
Wheel base, driving	15 ft. 6 in.
Wheel base, total	26 ft. 5 in.
Wheel base, engine and tender	53 ft. 7 in.



SECTIONS OF BOILER THROUGH FIREBOX, N. & W. LOCOMOTIVE.

RATIOS.	
Weight on drivers ÷ tractive effort	4.13
Total weight ÷ tractive effort	5.09
Tractive effort × diam. drivers ÷ heating surface	815.00
Total heating surface ÷ grate area	62.00
Firebox heating surface ÷ total heating surface, per cent	5.70
Weight on drivers ÷ total heating surface	60.00
Total weight ÷ total heating surface	74.00
Volume both cylinders, cu. ft	12.00
Total heating surface ÷ vol. cylinders	230.00
Grate area ÷ vol. cylinders	3.71
CYLINDERS.	
Kind	Simple
Diameter and stroke	21 × 30 in.
Kind of valves	12 in. piston
WHEELS.	
Driving, diameter over tires	56 in.
Driving, thickness of tires	3 in.
Driving journals, main, diameter and length	9 × 10½ in.
Driving journals, others, diameter and length	8½ ×10½ in.
Engine truck wheels, diameter	27 in.
Engine truck, journals	5½ × 10 in.
BOILER.	
Style	Wagon Top
Working pressure	200 lbs.
Outside diameter of first ring	70 in.
Firebox, length and width	99⅞ × 64¼ in.
Firebox plates, thickness	crown ⅜, sides ⅜, back ½ tube ⅝ in.
Firebox, water space	front 5½, sides 5, back 4 in.
Tubes, number and outside diameter	242—2¼ in.
Tubes, length	18 ft. 4⅞ in.
Heating surface, tubes	2603 sq, ft.
Heating surface, firebox	157 sq. ft.
Heating surface, total	2760 sq. ft.
Grate area	44.5 sq. ft.
Center of boiler above rail	112 in.
TENDER.	
Wheels, diameter	33 in.
Journals, diameter and length	5¼ × 9 in.
Water capacity	6000 gals.
Coal capacity	10 tons

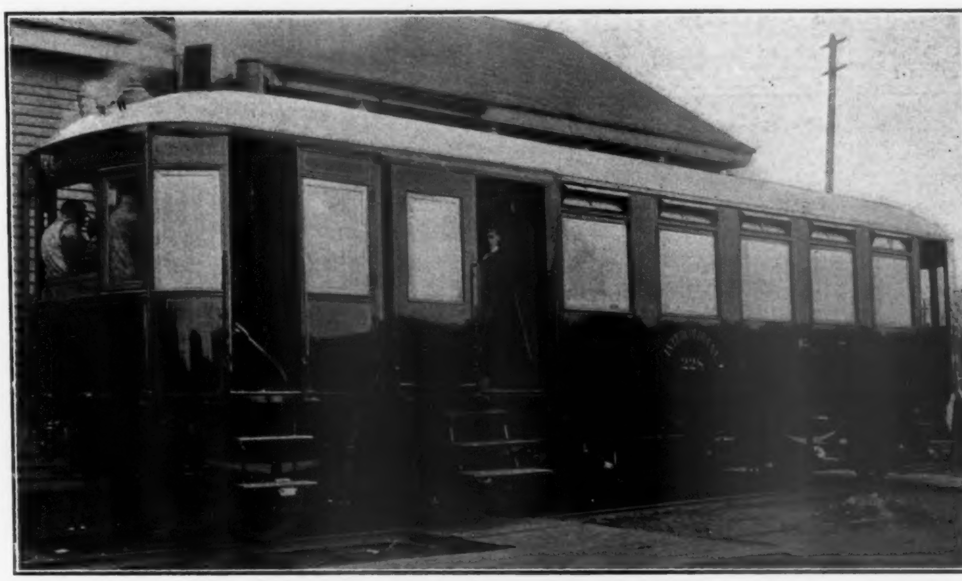
seated 50 passengers, shown on page 312 of the August, 1907, issue and of the car for the C. R. I. & P. Ry., which seated 52 passengers, illustrated on page 141 of the April issue. Reference to these articles can be made for a description and illustrations of this apparatus.

The official tests made on this car before its acceptance by the Railway Company were quite severe. It was operated a distance of 37 miles over the Intercolonial Railway from Moncton to Harcourt, which run was made in 62 minutes, the maximum speed being 43 miles an hour. On a one per cent. grade one mile long, during this run, a speed of 30 miles an hour was attained. The round trip, making a distance of practically seventy-five miles, was made with a coal consumption of 925 lbs., being equivalent to about 12.3 lbs. per mile. The guarantee of the car being 16½ pounds per mile, this test showed it to be 25 per cent. better than its guarantee. Another test was made over a distance of 26 miles with the motor car pulling a trailer weighing 24 tons. The average speed on this run was 31 miles per hour. The Ganz patents and apparatus in this country are controlled by the Railway Auto Car Company of New York.

MALLET COMPOUND LOCOMOTIVES IN ROAD SERVICE.

The Great Northern Railway has 25 Mallet compounds in road service between Spokane and Leavenworth, Washington, a division about 200 miles in length, on which the maximum grade is one per cent. The locomotives are successfully handling 1,450 tons, giving a speed of 10 miles per hour on the maximum grade. Prior to the assignment of the Mallet locomotives in this district consolidation locomotives, with a tractive force of 39,000 lbs., were being used and could handle but a little over 1,100 tons. Hence the Mallets are handling 30 per cent. more tonnage and are burning practically the same amount of fuel.

These locomotives were illustrated on page 213 of the June issue of this journal and weigh 302,650 lbs. total, of which 263,350 lbs. is on drivers. They are of the 2-6-6-2 type and have a tractive effort of 57,940 lbs. The drivers are 55 in. in diameter and the steam pressure is 210 lbs.



GANZ STEAM MOTOR CAR—INTERCOLONIAL RAILWAY OF CANADA.

GANZ STEAM MOTOR CAR.

INTERCOLONIAL RAILWAY.

On page 391 of the October issue of this journal is illustrated and described a steam motor car, three of which have recently been designed and built in the shops of the Intercolonial Railway of Canada. The same company has also received a 120 h.p. steam motor car of the Ganz type, the appearance of which is shown in the illustration.

This car was imported direct from the European works of the company and has a seating capacity of 40 passengers. It is divided into four compartments, the one at the forward end, 7 ft. long, containing the steam generator, control levers and all accessory apparatus. Back of this is a baggage compartment, 7 ft. long, which is followed by a smoking compartment seating eight passengers.

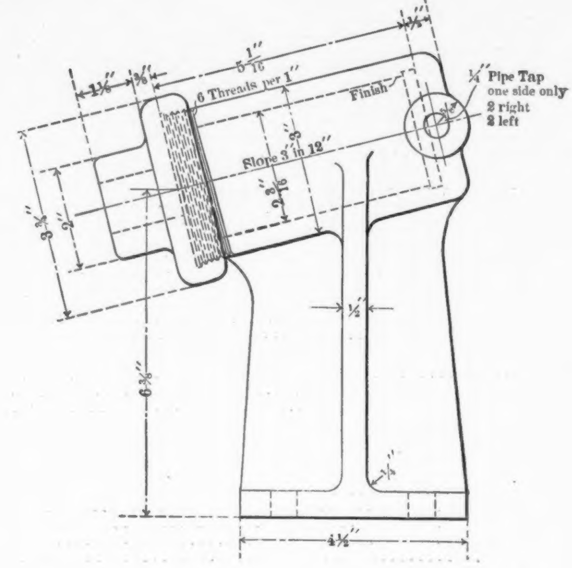
The framing and exterior finish is of steel, the interior finishings being hard wood. The seats are upholstered in leather. The car is heated by steam and lighted by acetylene gas.

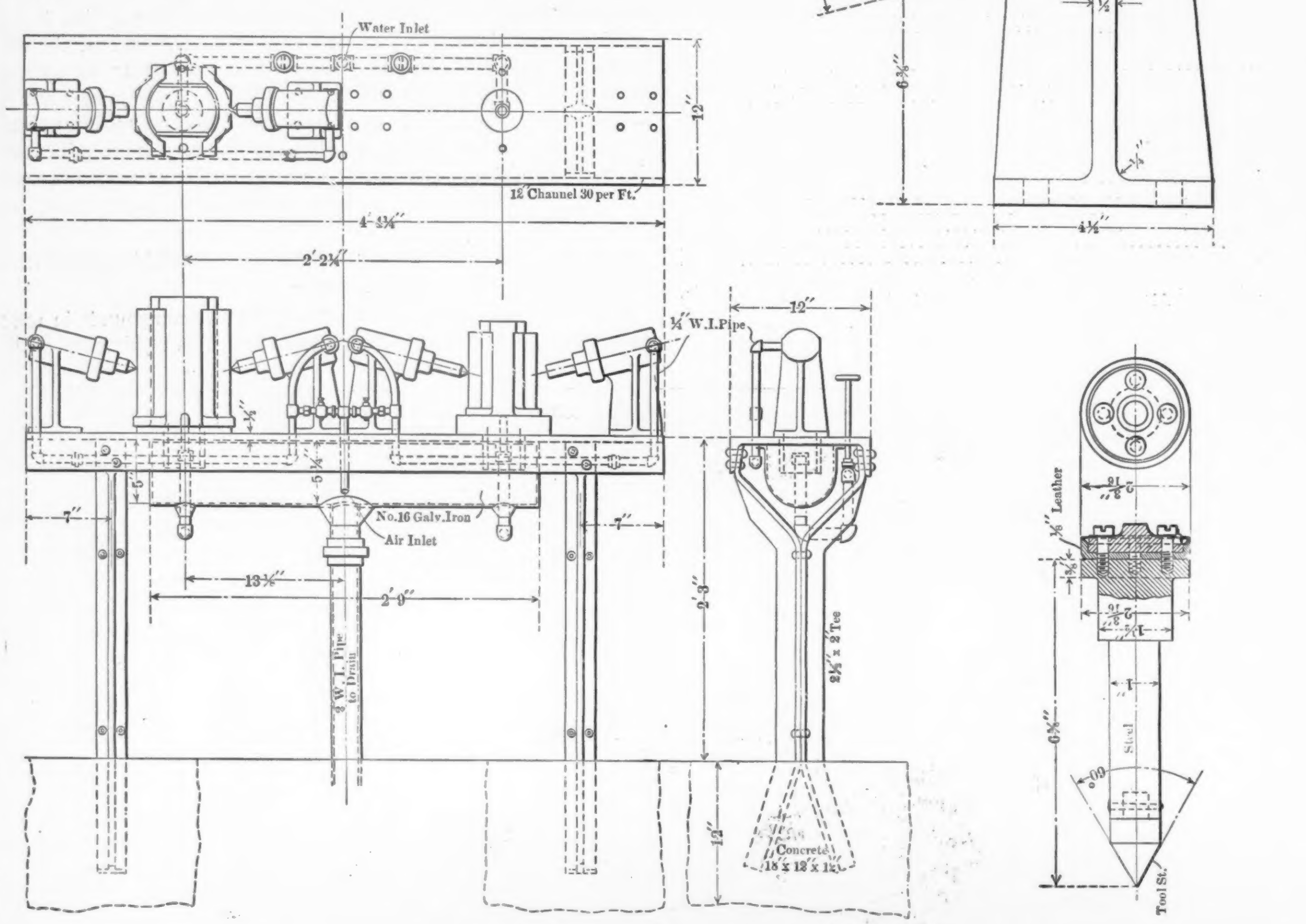
The steam generating apparatus and the steam motor are of the standard Ganz type, which has been illustrated in this journal in connection with a car built for the Erie Railroad, which

PRIZES FOR TRACK SUPERVISORS.—The Pennsylvania Railroad distributed $5,400 in prizes during the past month to the track supervisors whose tracks had been kept in the safest and most perfect condition. There was a prize of $1,200 for the line best maintained during the year and a prize of $1,000 for the division showing the greatest improvement during the year. There were also four prizes of $800 each for other divisions where the maintenance or improvement during the year has been especially good

LINING CAR BRASSES.

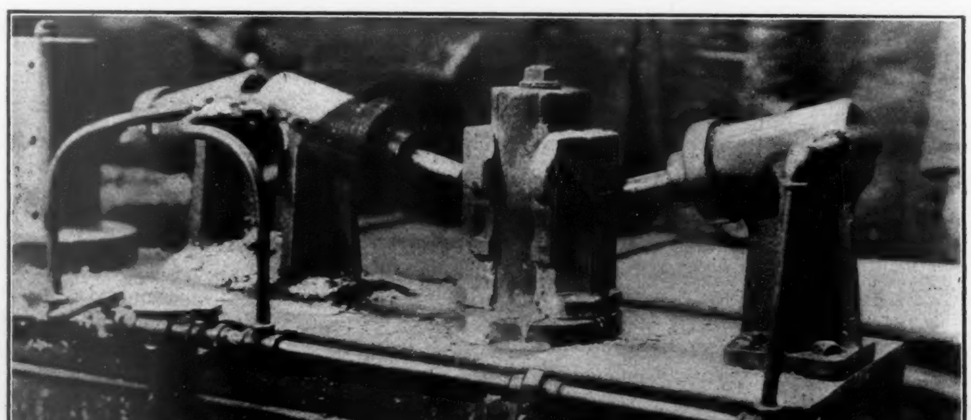
The illustrations show a device, in use at the Collinwood shops of the Lake Shore & Michigan Southern Railway, for lining car brasses. The apparatus consists of two pairs of air cylinders mounted on a 12-inch channel, as shown. The cylinders are bored to 2 3/16 in. The piston rod is inclined downward and pointed at the end so that when air is admitted to the cylinders the brasses are held firmly against the mandrel. A coil spring is fitted in the cylinder so that when the pressure is released the piston will be forced back and the brass can easily be removed.





DETAILS OF DEVICE FOR LINING CAR BRASS.

The mandrel is cored hollow and streams of water are played on the inside, by means of a pipe cap with four ⅛-in. holes in it, which is placed on the end of the supply pipe, thus cooling the lining metal as it is poured. Guide strips are cast on each side of the mandrel to hold the brasses the proper distance from it. The brasses are tinned before lining.

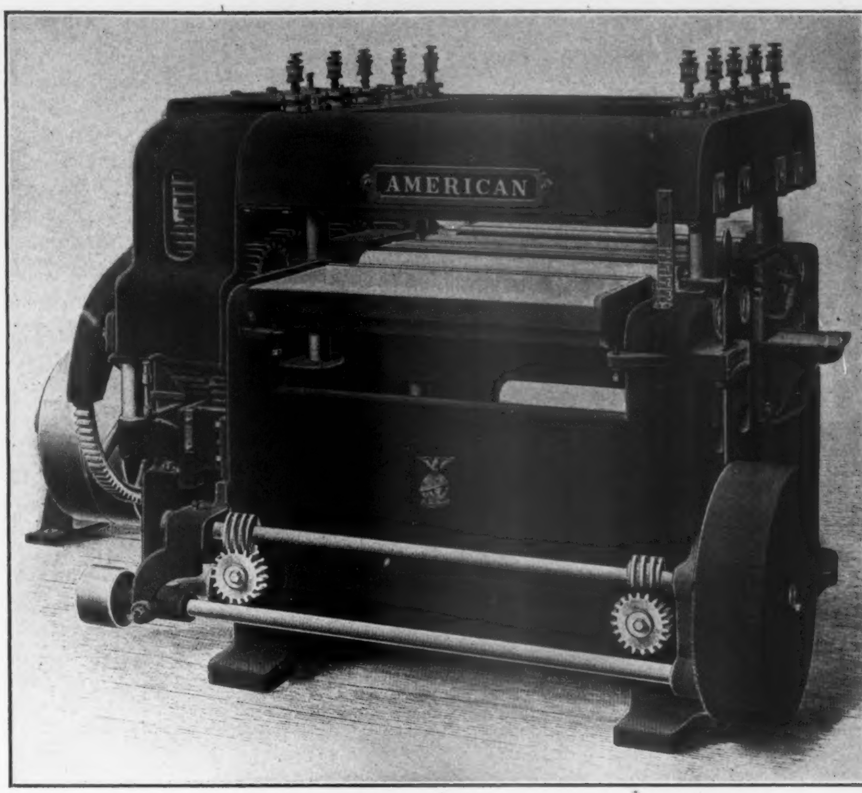


LINING CAR BRASSES—COLLINWOOD SHOPS.

New Design of Pedestal Binder.—Our attention has been called to the fact that the pedestal binder published on page 361 of the September issue, under the above caption, is not altogether new, since this type of binder was patented by Mr. John Player, now consulting engineer of the American Locomotive Company, on December 9, 1890, and has been in use in slightly modified forms on the New York, Chicago & St. Louis Rail-

road, the Lake Shore & Michigan Southern Railway, and some other roads since that date. Several modifications of this design have been made to suit special conditions. One of these is adapted for the rear pedestal of trailing truck engines where the frame is of the slab form and set down behind the pedestal jaw so that it is not practicable to use a foot. In that case the binder is hinged around a 2½ in. pin passing through the frame at the rear and has a set screw arrangement, similar to the one illustrated, in front.

30-INCH SCRAPING MACHINE.



AMERICAN 30-INCH SCRAPING MACHINE.

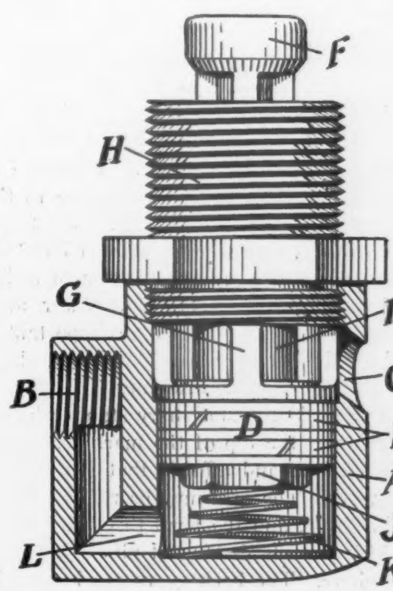
The illustration shows a 30-in. scraping machine, as made by the American Wood Working Machinery Company, Rochester, N. Y. These machines perform about the same function as sanders and are better adapted for certain classes of work. A thin knife held firmly in a stock, with its edge projecting slightly above the face of the stock, forms the principal feature of the machine. The work is fed over the knife by powerfully driven smooth rolls operating at a high speed. A thin shaving is removed, leaving a smooth surface ready for the finishing room.

As may be seen, the frame is of heavy and substantial construction. There are eight feed rolls all driven by heavy gears. The stock which holds the knife is in two parts with a slot for the knife in the center. The top face is made of chilled iron accurately ground to a true surface and having in the center a flat face of 4½ in. against which the knife is placed. On the other side of the knife is an accurately finished plate, which is drawn up against the knife by set screws, holding it rigidly. Two of these stocks are furnished with each machine, and when one knife becomes dull it can be withdrawn and the other one instantly inserted without stopping the machine. The pressure roll over the knife is controlled by strong springs, which hold the work firmly to the knife at all points. The knife may be used for cutting on both edges and may be ground until it becomes too narrow to be firmly held in the stock. The machine illustrated has a capacity for pieces 30 in. wide and 4 in. thick. These machines are also made in three other sizes, 12, 20 and 42 in.

Largest Steamship in the World.—The steamship Lusitania of the Cunard Line, which has broken all records for speed of transatlantic liners, is driven by four Parsons turbines, each driving a separate screw. The two inner ones are high pressure turbines and the two outer ones are low pressure. There are also two smaller turbines for the astern movement. The propellers were designed to make about 140 revolutions per minute, the turbines making the same. The rotor of the high pressure turbines is 96 in. and the low pressure 140 in. in diameter. The blades range from 2¼ to 22 in. in length. The vessel contains 25 Scotch boilers, of which 23 are double ended, with eight furnaces, and two are single ended, giving a total of 192 furnaces. The steam pressure is 195 lbs. The total heating surfaces of all the boilers is 158,350 sq. ft. and the total grate area is 4,048 sq. ft. The turbines are designed to give a total horse-power of 68,000. The vessel measures 785 ft. over all and is 88 ft. broad at the widest point, the mean draught being 33 ft. 6 in. and the displacement 38,000 tons. During its trials this vessel made an average speed of 25.4 knots on a 48 hour run.

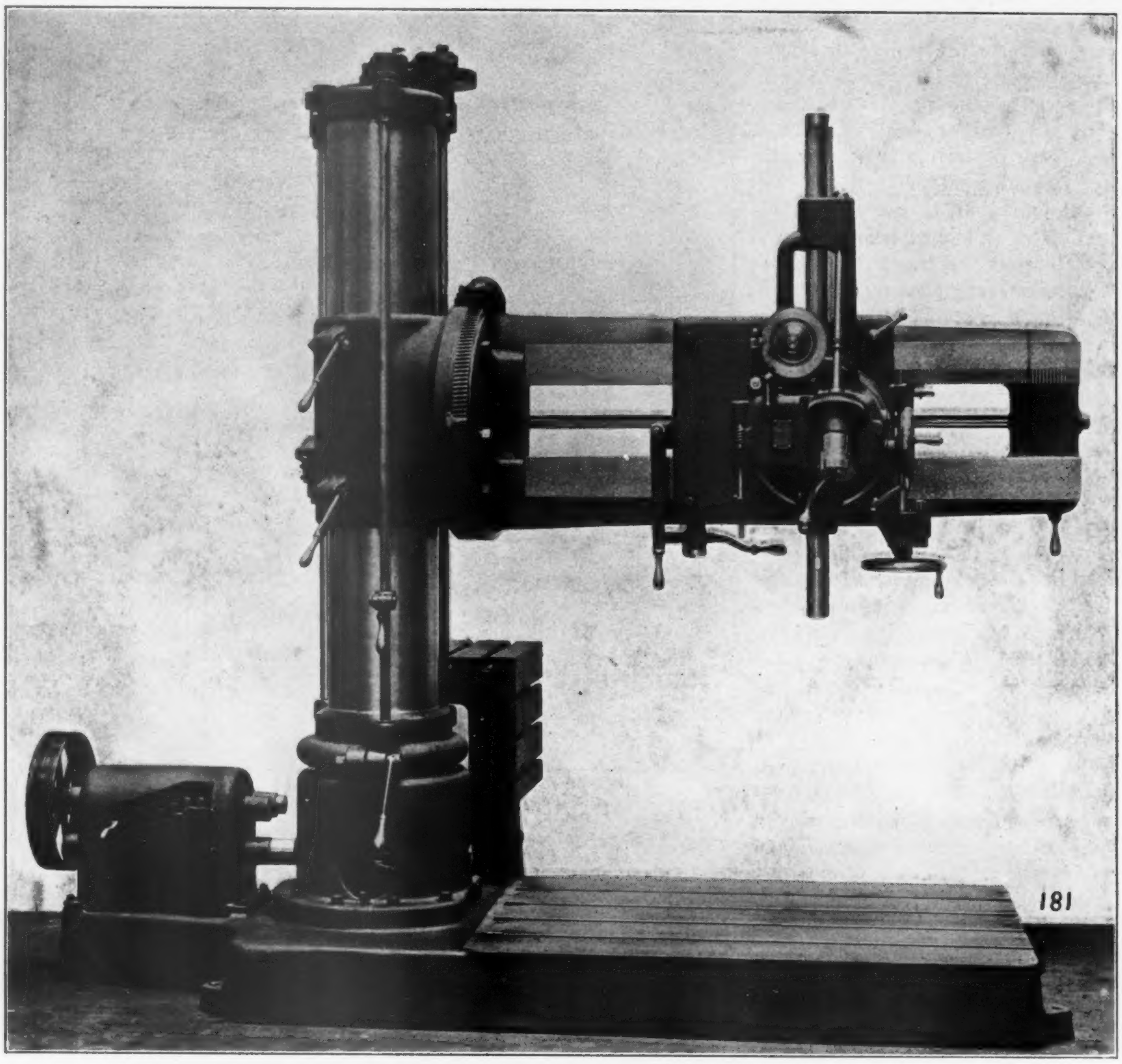
AUTOMATIC CYLINDER COCK.

A sectional view of the Dolph automatic cylinder cock is shown in the accompanying illustration. When steam is being used the pressure on the upper surface of the winged valve F forces it down on its seat. When steam is shut off the spiral spring K forces the piston D upward, carrying with it the valve F and permitting the cylinder condensation to escape through the opening C in the valve body. In case it should be necessary to open the cylinder cock while steam is being used, compressed air is admitted at B, passes down through the passage L and underneath the piston D, forcing it upward against the pressure of the steam on the valve F and opening the cock. Compressed air is sup-



plied from the main reservoir through an operating valve in the cab.

In addition to the advantages gained due to the automatic action, the awkward and ofttimes unsatisfactory cylinder cock rigging is done away with; there is considerably more clearance between the road bed and the bottom of the cock, thus reducing the liability of its being torn away. These valves are being used on several railroads with satisfactory results and are made by the Dolph Valve Company with offices at Buffalo, N. Y., and Erie, Pa.



NEW BICKFORD UNIVERSAL RADIAL DRILL.

NEW UNIVERSAL RADIAL DRILL.

The Bickford Drill & Tool Company, Cincinnati, O., is placing a new line of universal radial drills on the market, similar to the one shown in the illustration. It is claimed that the design of the arm offers much greater resistance to the combined stresses of twisting and bending than in their former designs. Also that this, combined with the exceptional facilities which the open form of arm offers for the introduction of a driving mechanism commensurate with the strength, power and durability obtainable in the other parts, marks an important advance in universal radial drill construction—obtaining a degree of efficiency equal to that of a plain machine.

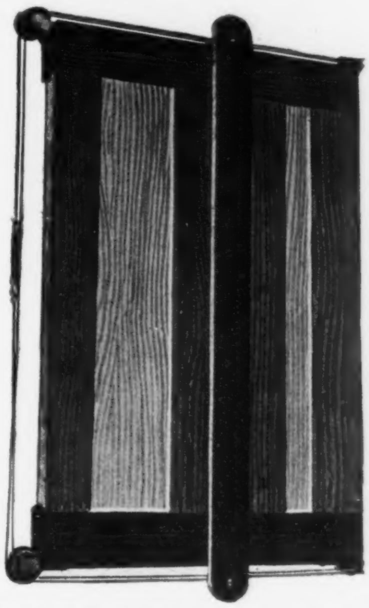
The sleeve is mounted on a stationary stump which extends up to and has a bearing at the top of the machine. This is equivalent to a double column, and affords that stiffness which is so essential to true work. The arm may be rotated through a complete circle on its girdle, and the head through a complete circle on its saddle, which permits drilling at all angles radiating from the center of a sphere. The back gears are located back of the saddle and may be engaged or disengaged from the front of the machine while it is running. They furnish three changes of speed, each of which exerts at the spindle more than two and one-half times the pulling power of the next faster one. The spindle has fifteen changes of speed with the cone drive and twenty-four with the gear drive, and is provided with both hand and power feed, quick advance and return, safety stop, automatic trip, dial depth gauge and hand lever reverse. An engraved plate attached to the speed box shows how to obtain the proper speeds for different diameters of drills.

The depth gauge answers a double purpose: it enables the operator to read all depths from zero, thus doing away with the usual delays concomitant to scaling and calipering; it supplies a convenient means for setting the automatic trip, the graduations showing exactly where each dog should be located in order to disengage the feed at the desired points. The automatic trip operates at as many different points as there are depths to be drilled at one setting of the work; in addition, it leaves the spindle free, after any intermediate tripping, to be advanced, or raised and advanced, or traversed its full length, without disturbing the setting of the dogs; it also throws out the feed when the spindle reaches its limit of movement. The feeding mechanism furnishes eight rates of feed, ranging in geometrical progression from .007 in. to .064 in. per revolution of spindle; each of these is instantly available, eliminating all loss of time incident to shifting a belt or to operating under a feed of unnecessary fineness. An engraved plate attached to the head shows the operator how to obtain each of the feeds.

The tapping mechanism is located on the head, and permits the backing out of taps at any speed, regardless of that used in driving them in. It is fitted with a friction clutch operated by a lever, the handle of which extends around under the arm within convenient reach of the operator. The driving mechanism is incased in a box made fast to the base of the machine, and consists essentially of a pulley, a cone of seven gears, a ratchet, ratchet gear and operating lever, the mere shifting of which from one notch to another furnishes any one of eight speeds. This box, taken in connection with the back gears on the head, gives the operator a choice of twenty-four carefully selected speeds, each of which is instantly available. The machine is furnished as either half or full universal, each of these styles being made in three sizes—4, 5 and 6 feet.

DRAWING BOARD PARALLEL MOTION ATTACHMENTS.

The difficulty of doing accurate work on a large drawing board, with an ordinary tee square, is too well recognized to require comment. There are a number of devices on the market for using a straight-edge, in place of a tee square, with attachments for keeping it in a parallel position. The important feature of the parallel motion attachments, which are clearly shown on the accompanying engraving, is the use of ball bearings in connection with the wheels, or pulleys, at the corners of the board. The wheels do not require any readjustment, after once



PARALLEL MOTION ATTACHMENTS FOR DRAWING BOARD.

being attached, require no lubrication and reduce the friction, and therefore the liability of distorting the motion, to a minimum.

The attachments may be easily applied and the board is not at all disfigured, if it is desired to remove them. They are of steel, nickel plated, and neat and attractive in appearance. The cost is so low, and the possibility of greater accuracy and rapidity of doing work on the smaller, as well as large boards, is so great that no drawing room should be without them. They are made by the Knipe Manufacturing Company, manufacturers of the Knipe multiple ball bearings, with offices in the Drexel Building, Philadelphia, and works at Worcester, Mass.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

The sixth annual convention of the National Machine Tool Builders' Association was held at the Hotel Imperial, in New York, October 15 and 16. The reports indicate that the association is in splendid condition. The membership has been increased from 76 to 81 since the spring meeting. Among other things a committee report was presented as to the value of exposition displays and a standard form of diploma was adopted for graduate apprentices; also a form of contract designated as "The National Machine Tool Builders' Apprenticeship Contract."

The spring meeting will be held at Atlantic City. The following officers were elected: President, Fred. L. Eberhardt, Gould & Eberhardt, Newark, N. J.; first vice-president, C. A. Johnson, Gisholt Machine Company, Madison, Wis.; second vice-president, E. P. Bullard, Jr., Bullard Machine Tool Company, Bridgeport, Conn.; secretary, P. E. Montanus, Springfield Machine Tool Company, Springfield, Ohio; treasurer, W. P. Davis, W. P. Davis Machine Company, Rochester, N. Y.

STREET CAR ACCIDENTS IN NEW YORK CITY.—A table which has recently been issued by the Public Service Commission of New York City shows that the total number of accidents from August 4 to 31 on the transit lines within New York City was 5,500. There were 159 of what are classed as serious accidents in which 42 people were killed.

PERSONALS

Mr. W. J. Buchanan, master car builder of the Bessemer & Lake Erie R. R., with office at Greenville, Pa., has resigned.

Mr. W. G. Wallace, superintendent of motive power of the Ann Arbor Railroad and the Detroit, Toledo & Ironton, has resigned.

Mr. F. M. Titus has been appointed general inspector of the American Locomotive Company, with headquarters at Schenectady, N. Y.

Mr. A. T. Livingston, acting storekeeper, has been appointed storekeeper of the New York Central & Hudson River R. R. at Albany, N. Y.

Mr. E. M. Peden has been appointed superintendent of motive power and rolling stock of the Santa Fe Central Ry., with office at Estancia, N. M.

Mr. S. H. Spangler has been appointed master mechanic of the St. Louis, Watkins & Gulf Ry., with office at Lake Charles, La., vice Mr. J. C. Ramsey.

Mr. James Stockton, general foreman of the New Orleans & Northeastern R. R., has resigned to become master mechanic of the New Orleans Terminal Co.

Mr. T. Rumney, mechanical superintendent of the Erie R. R., with office at Meadville, Pa., has been promoted to general mechanical superintendent, with office in New York.

Mr. F. W. Dickinson, general foreman of the car department of the Bessemer & Lake Erie R. R., at Greenville, has been promoted to master car builder, succeeding Mr. Buchanan.

Mr. J. H. Cragin has been appointed general storekeeper of the San Pedro, Los Angeles & Salt Lake R. R., with offices at Los Angeles, Cal., to succeed Mr. L. B. Stiles, resigned.

Mr. Joseph W. Walker has been appointed chief air and motive power inspector of the Pennsylvania Railroad, Western Pennsylvania grand division, with office at Pittsburg, Pa.

Mr. Edward F. Fay, general foreman of shops of the Union Pacific R. R. at Omaha, Neb., has been appointed master mechanic at Denver, Colo. He is succeeded by Mr. George Brown.

Mr. William Scnlafge, assistant mechanical superintendent of the Erie R. R. at Meadville, has been made mechanical superintendent of the Erie grand division, with office at Jersey City, N. J.

Mr. J. H. Nash, division master mechanic of the Illinois Central R. R. at East St. Louis, Ill., has been appointed division master mechanic at Paducah, Ky., vice Mr. R. E. Fulmer, resigned.

Mr. A. G. Trumbull, assistant mechanical superintendent of the Erie R. R. at Meadville, has been made mechanical superintendent of the Ohio division and the Chicago & Erie, with office at Cleveland, Ohio.

Mr. A. W. Wheatley, general inspector of the American Locomotive Company at Schenectady, has been appointed a manager of that company, with headquarters at the Ottawa Bank Building, Montreal, Canada.

Mr. E. J. Harris, general foreman of shops of the Chicago, Rock Island & Pacific Ry. at Valley Junction, Ia., has been appointed master mechanic at that point, succeeding Mr. D. W. Cunningham, resigned.

Mr. A. Buchanan, Jr., superintendent of motive power of the Central Vermont Ry., has resigned to accept a position on the Public Service Commission, 2nd district, New York, with headquarters at Albany, N. Y.

Mr. R. C. Evans has been appointed superintendent of the motive power and car departments of the Western Maryland R. R., with headquarters at Union Bridge, Md., in place of Mr. William Miller, resigned, account of ill health.

Mr. J. E. Cameron, superintendent of motive power of the Atlanta, Birmingham & Atlantic R. R. at Fitzgerald, Ga., has resigned and will devote his entire attention to construction work as superintendent of construction at Talladega, Ala.

Mr. James Holden, locomotive, carriage, and wagon superintendent of the Great Eastern Railway, England, will retire at the end of the year. Mr. Stephen Dewar Holden, assistant locomotive superintendent, has been appointed to succeed him.

Mr. Martin P. Ford, a charter member of the Master Car Builders' Association and designer of a sleeping car which was in service for several years before Pullman's invention was brought out, died at Columbus, O., on Sept. 16. Age, 83 years.

Mr. R. Tawse, master mechanic of the Ann Arbor Railroad, has been appointed superintendent of motive power of the Ann Arbor and the Detroit, Toledo & Ironton, with headquarters at Jacksonville, Ohio. Mr. Tawse succeeds Mr. W. G. Wallace, resigned.

Mr. Robert McKibben, master carpenter of the Monongahela division of the Pennsylvania Railroad at Pittsburg, Pa., has been promoted to master carpenter of the Middle division, with headquarters at Altoona, Pa. He succeeds Mr. A. H. Kline, promoted.

Mr. H. Montgomery has been appointed superintendent of motive power and equipment of the Bangor & Aroostook R. R., with office at Milo Junction, Me., and the position of assistant superintendent of motive power and equipment is abolished. Mr. Montgomery succeeds Mr. Orlando Stewart, resigned.

Mr. Alfred Lovell has tendered his resignation as superintendent of motive power of the Atchison, Topeka & Santa Fe Ry. to engage in private business. He has been in the service of the Santa Fe since September, 1902, when he became assistant superintendent of motive power, and in February, 1905, was promoted to the office of superintendent of motive power. Mr. Lovell is a graduate of the Worcester Polytechnic Institute class of '73. After several years' experience on eastern roads, he, in 1890, entered the service of the Northern Pacific Ry. as superintendent of construction of new shops at Tacoma, and from 1894 to 1902, was successively acting mechanical engineer, engineer of tests, assistant superintendent of motive power and superintendent of motive power of that road.

BOOKS

Switches and Turnouts. By Howard Chapin Ives. Bound in paper; 6 x 9 in.; 40 pages. Published by the Worcester Polytechnic Institute. Mr. J. D. Williams, sales agent, Worcester, Mass. Price, 50c.

This book is a reprint of three articles which appeared in the Journal of the Worcester Polytechnic Institute. It gives descriptions of the different forms of switches and their effect upon the lead and gives the theory, including the mathematics, used in the design of switches and turnouts. The arrangement is in the form of problems followed by their solution.

Modern British Locomotives. By A. T. Taylor. Bound in cloth; 110 pages; 5 x 7½ in. Published by Spon & Chamberlain, 123 Liberty Street, N. Y. Price $1.80.

This book includes 100 diagrams of British locomotives, giving the principal dimensions, weights, etc. The diagrams are grouped according to type and represent the latest practice on all of the leading railways of Great Britain.

Railway Corporations as Public Servants. By Henry S. Haines. Bound in cloth; 5½ x 8 in.; 226 pages. Published by the Macmillan Co., 66 5th Ave., New York. Price $1.50.

This book contains the substance of the course of lectures delivered before the Boston University School of Law and is to some extent supplementary to a previous work of the same author on "Restrictive Railway Legislation." It describes the development of such legislation since the passage of the act to regulate interstate commerce. The author is a member of the A. S. C. E.; A. S. M. E.; was formerly vice-president and general manager of the Plant System; is an ex-president of the American Railway Association and a commissioner of the Southern States Freight Association.

Poor's Manual of Railroads 1907. 40th Annual number. Published by Poor's Railroad Manual Co., 68 William St., New York. Price $10.00.

This is in all respects the most complete volume of the entire series, embracing 2,000 pages of condensed information concerning the railroad, street railway and industrial corporations of the U. S. The introduction gives the statistics of the American railway system as a whole for the year ending 1906 and is highly interesting and instructive. It shows, for instance, that the average rate per passenger mile for the year ending 1906 was 2.011c. as against 2.028c. in 1905. The average freight revenue per ton mile was .776c. as against .784c. The average interest rate on bonds was 3.99 per cent. and the average dividend rate on railroad stock was 3.63 per cent. The information contained in the introduction and in the Manual itself is of special interest at present owing to the agitation of railway matters in the press and the regulation of railway affairs by the different legislatures.

The Blacksmith's Guide. By J. F. Sallows. Published by The Technical Press, Brattleboro, Vt. Pocket size, 4½ x 7 in.; 160 pages; 165 illustrations; cloth binding, $1.50; leather, $2.00.

This book was written by a practical blacksmith, who has had a very wide experience, and who is at present foreman blacksmith of the Reo Motor Car Company, Lansing, Mich. The book is well printed on heavy paper and the illustrations are especially good. The sub-divisions of the different chapters are indicated by side heads in bold-face type. After some general suggestions, the method of making various tools for the blacksmith and machine shop is clearly and briefly described. Directions for making different kinds of welds are then given. The second chapter considers the making of hand and machine cutting tools. Following this are chapters on hardening and tempering high speed steel, case hardening and coloring, brasing, and general blacksmithing. There are three colored illustrations, one showing a heat chart, another a temper chart and the third the effects obtained by case-hardening and coloring a wrench. A folder shows the working drawings for a coal burning case-hardening furnace.

The Strength of Wood as Influenced by Moisture:—Published by the Forestry Service, U. S. Department of Agriculture, Washington, D. C. Sent free upon application.

The effect of water in softening organic tissue, as in wetting a piece of paper or a sponge, is well known, as is also the stiffening effect of drying. The same law applies to wood. By using different methods of seasoning, two pieces of the same stick may be given very different degrees of strength. Wood in its green state contains moisture in the pores of the cells and also

in the substance of the cell walls. As seasoning begins the moisture in the pores is first evaporated. This lessens the weight of the wood but does not affect its strength and it is not until the moisture in the substance of the cell walls is drawn upon that the strength of the wood begins to increase. From this point to that of absolute dryness the gain in the strength of wood is somewhat remarkable. In the case of spruce the strength is multiplied four times; and this wood, in small sizes, thoroughly dried in the oven, is as strong, weight for weight, as steel. This publication includes tables and complete information showing the strength of representative woods for all degrees of moisture, from the green state to absolute dryness, as well as the effects of re-soaking.

Laying Out for Boiler Makers. Bound in cloth; 10 x 13 in.; 189 pages. Published by the Boiler Maker, 17 Battery Place, New York. Price $4.00.

This book has been compiled for the purpose of giving a practical boiler maker the necessary information to enable him to lay out in detail the different types of boilers, tanks, stacks and irregular shape metal work. The practical application of many of the principles of geometry, mechanics, etc., involved in this subject have been explained in a practical way in connection with different jobs of laying out which form a part of the every day work in every boiler shop. The subject is handled entirely from a practical standpoint and contains only such theory and mathematics as are absolutely necessary for the practical work. The first two chapters explain the methods of laying out by orthographic projection and triangulation, since these are the two principal methods used in solving any problems in laying out. A few simple problems are given in each case, from which the application of the methods to more complicated problems may be learned. The chapters which take up the detailed layouts of different types of boilers also give the rules for determining the size, shape and strength of the different parts. The work covers its field very completely and is profusely illustrated with half-tones and clear-cut line drawings. The matter contained in the book first appeared in the pages of the *Boiler Maker* and have been reprinted from that source. This work will be found to be of great practical value to all boiler makers and boiler maker foremen.

Proceedings of the Railway Storekeepers' Association. Fourth annual meeting, held at Chicago, May 20-22, 1907. Cloth, 213 pages (not including illustrations and folders), 6 x 9 in. Secretary, Mr. J. P. Murphy, Collinwood, O.

Several of the papers are of special value to the mechanical department officials. Messrs. J. H. Waterman, of the Burlington, N. M. Rice, of the Santa Fe, and H. A. Anderson, of the Pennsylvania, each read papers on "Should the Jurisdiction of the Storekeeper, or Supply Agent, Extend to the Time the Material Is Actually Used?" This question precipitated a lively and extended discussion. The topic, "To What Extent Is the Store Department Beneficial to the Motive Power Department?" was considered in papers by Messrs. H. W. Jacobs, of the Santa Fe, C. B. Foster, of the T. St. L. & W., and L. R. Johnson, of the Canadian Pacific.

Other important papers were: "A Unit of Comparison," by Mr. Geo. G. Yeomans: "Reports and Statistics of Value to the Store Department"; "Importance of Proper Loading of Material at General Storehouses to Conserve Cars and Expedite Delivery"; "The Modern Supply Car as a Factor of Economy in the Distribution of Material"; "Benefits Derived from the Classification of Material"; "The Handling of the Storekeeper's Accounts"; "Best Record for Material Received, and Passing Invoices"; Is the Store Department Deficient Without a Traveling Storekeeper?" and "The Most Practical Railway Store Department Organization." Individual papers were presented by Mr. M. B. Wild, statistician of the Baltimore & Ohio; by Mr. H. C. Stevens on "Information of Importance which Should at All Times be in the Hands of the General Storekeeper," and by Mr. H. E. Ray on "Reorganization of the Store Department on the Santa Fe."

The association now has a membership of 253, an increase of 40 per cent. in one year. This volume, like its predecessors, is well printed and carefully arranged. A feature which adds considerably to its value and appearance is the half-tone illustrations showing the arrangement of different "up-to-date" store houses, or of apparatus used in connection with them. There are 26 of these illustrations.

Development of the Locomotive Engine. By Angus Sinclair. Bound in cloth; 6 x 9; 661 pages; illustrated. Published by the Angus Sinclair Company, New York. Price $5.00.

The careful student of any subject finds the history of his specialty to be a most valuable part of his equipment and the study of the development of any art, practically of the mechanic arts is always interesting even to those who are not intimately connected with it. A work of this kind, to be successful, should be written by a man of broad experience, wide acquaintance and long connection with his subject, who is able to see the various stages of the development in their proper prospective and to eliminate the large amount of unimportant material.

The book we are considering seems to fulfil these conditions in every way. The author is one of the best known students and writers on locomotive affairs in the country, who numbers among his friends the prominent figures responsible for the tremendous progress of the locomotive during later years, in which progress he himself has greatly assisted. The book contains many photographs and brief sketches of the personal record of these men, as well as of those great minds of the earlier periods. It fulfils its title very completely by showing each step in the development of the locomotive as a whole and of its more important parts. The chapters showing the development in America are arranged in sections covering the progress on each road, beginning with a general chapter illustrating a few of the earliest imported and American engines, followed by chapters on the B. & O. Railroad, Camden & Amboy R. R., Philadelphia & Columbia R. R., Baldwin Locomotive Works, Sellers and other Philadelphia pioneers in locomotive building; New York Central R. R., New England Railways, etc. The development on western railroads and chapters on locomotive boilers, valve gears, freaks and curiosities, train brakes, accessories, present locomotive works, and a chapter entitled "The Locomotive Today" complete the work. We would recommend this book to all students of locomotive history.

CATALOGS

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS JOURNAL.

COLD METAL SAW.—Catalog No. 5 from the Lea Equipment Company, 136 Liberty street, New York, describes in detail the Lea-Simplex cold metal saw. These are made in several sizes and may be arranged for either belt or motor drive.

"SPIKE STRUT."—The Maryland Railway Supply Company, Continental Building, Baltimore, Md., is issuing a small catalog illustrating and describing the "Spike Strut," which is designed to reinforce track spikes wherever greater resistance is required.

OIL HOUSE EQUIPMENT.—Bulletin No. 4002, recently issued by S. F. Bowser & Co., Fort Wayne, Ind., is devoted to the Bowser system of oil storage, as specially adapted to the needs of railway store houses, terminals, signal towers, etc. It describes in detail the construction of the different styles of pumps, tanks and accessories manufactured by this company and is profusely illustrated with views of installations recently completed.

BALL AND ROLLER BEARINGS.—The Standard Roller Bearing Co., 48th street and Girard avenue, Philadelphia, is issuing catalog No. 12, containing illustrations, descriptions and details of sizes and prices of the large variety of ball and roller bearings manufactured by it. These bearings are designed for practically all purposes where friction is to be overcome and are shown in a surprisingly large number of shapes and sizes, for all purposes from a bicycle to a street car.

ELECTRICAL APPARATUS.—The Fort Wayne Electric Works, Fort Wayne, Ind., is issuing Bulletin No. 1100 on the subject of type L, small, direct-current generators, which are illustrated and described both as to their construction and application to machine tools and similar apparatus. Bulletin No. 1098 is on the subject of type M. P. L. belted generators, which are described in detail. These generators are made in capacities from one to four hundred k. w. The same company is issuing instruction book No. 3028 on the subject of single phase integrating induction wattmeters.

TATE FLEXIBLE STAYBOLT.—The Flannery Bolt Company, 308 Frick Building, Pittsburg, is issuing a leaflet illustrating a locomotive boiler fitted with a complete set of flexible stay bolts and containing a complimentary letter recently received from a prominent mechanical superintendent.

METALLIC PACKING.—H. W. Johns-Manville Co., 100 William street, New York. is issuing a catalog descriptive of the Morris metallic packing, of which it has undertaken the exclusive sale. This packing has been in use for several years and has proved itself to be remarkably successful under the most severe conditions. The catalog illustrates the packing as used on both rotary and reciprocating valve stems.

POND RIGID TURRET LATHE.—A handsomely illustrated catalog from the Niles-Bement-Pond Company, 111 Broadway, New York. These machines are made in two sizes, 21 and 28 inch, and are designed for producing economically work ordinarily done on engine lathes and heavy bar work. The first part of the catalog describes the machines in detail, with several illustrations. The tool equipment is then considered, after which illustrations are given showing how various classes of work are handled. This is followed by drawings of different types of work which may be done to advantage on these lathes.

THERMIT WELDING INSTRUCTIONS.—The Goldschmidt Thermit Co., 90 West street, New York City, is issuing several pamphlets giving complete and specific directions covering the various applications of thermit, special attention being given to the repair of locomotive parts. The moulds for use in welding frames and other parts are illustrated and the best method of application and the procedure preceding the ignition of the thermit, as well as following it, is clearly explained. The chemical and physical changes following the ignition are briefly covered and every step in the operation of thermit welding is carefully explained.

MODERN WELDED PIPE.—The National Tube Company, Frick Building, Pittsburg, Pa., is issuing a very attractive booklet on the subject of modern welded pipe, which describes in detail the manufacture from the ore to the finished product. The subject is treated in a popular manner and is intended to familiarize all users of pipe with the properties of the materials involved and their treatment in the course of manufacture. It is profusely illustrated with excellent half-tone illustrations, giving views of the different processes, from the mining of the ore to the testing of the pipe. This book will be found interesting and useful to all users of piping of any kind.

HYDRAULIC PUMPS.—The Watson-Stillman Co., 26 Cortlandt street, New York, is issuing sectional catalog No. 71, which, like other catalogs from the same company recently mentioned in this column, is an assortment of sheets selected from its large amount of printed matter, which in this case relate specially to hydraulic pumps and accessories. It includes illustrations and descriptions, together with prices, of both hand and power driven pumps in all conceivable shapes and sizes, many of which have been developed for special purposes. It also includes many illustrations with accompanying descriptive matter of hydraulic accessories, such as accumulators, accumulator attachments, gauges, packing rings, etc.

THE REPUBLIC FRICTION DRAFT GEAR.—The Republic Railway Appliance Company, Chicago, is issuing an attractive catalog descriptive of its type of friction draft gear. The gear is shown by half-tone illustrations, line drawings and phantom views as applied to cars with both steel and wooden sills, for freight and passenger service. This gear is composed of the ordinary M. C. B. spring and buffer plate, with the friction parts so arranged as to act as an auxiliary for increasing the capacity of the spring gear. It occupies the same relation to the coupler and attachments as does the ordinary spring draft gear and the entire apparatus is mounted in the yoke and placed within the pocket as in the ordinary construction.

HYDRAULIC ENGINES.—The Rife Hydraulic Engine Mfg. Co., 111 Broadway, is issuing a catalog descriptive of the Rife hydraulic engine, which is constructed upon an entirely new application of hydraulic principles. These engines will work under a fall of two or more feet, will force water to a height of 30 feet for each foot of fall and are entirely automatic, needing practically no attention except the renewing of valves every few years. The principle of the engine, together with a complete description of its construction and operation, thoroughly illustrated with half tone and line drawings, is given in the catalog. These engines are made in capacities up to one million gallons per day and they pump to a maximum height of 500 feet.

NEW G. E. BULLETINS.—The General Electric Company is issuing three new bulletins, one of which is descriptive of mercury arc rectifiers and bears the No. 4530. These devices are for the purpose of changing alternating current into direct current for charging storage batteries and other commercial purposes. They are comparatively inexpensive, requiring small floor space and have remarkably high efficiencies. The bulletin describes the theory and construction very clearly. Bulletin No. 4534 illustrates and describes horizontal shaft types of Curtis steam turbines, direct connected to generating sets up to 300 k. w. capacity. The third bulletin, No. 4533, is on the subject of the Wright demand indicators, which have been extensively adopted for determining the load factor, the maximum output of generators, transformers, feeders, etc. The theory of operation and general construction of this device are clearly illustrated in the bulletin.

FLEXIBLE COMPOUND.—The Flexible Compound Company, 3607 Haverford avenue, Philadelphia, is issuing several leaflets descriptive of this compound, which show its advantages in special classes of work. The compound is a perfect water-proof liquid, which, when mixed with paint or varnish, gives them flexibility and provides positive protection against the ravages of moisture, salt air, locomotive gases, etc. It prevents the peeling and cracking of paints and varnishes, will protect belts from dampness and renders iron and steel immune from the oxidizing effects of moisture or gases. It has excellent insulating properties for use in electrical work. The leaflets give directions for using and suggest many ways in which it will be found to be of great advantage.

CAR LIGHTING BY ELECTRICITY.—The Safety Car Heating & Lighting Company, 2 Rector street, New York, is issuing a very attractive, standard 9 x 12 in., catalog on the subject of electric appliances for car lighting. This company has developed a new system of electric car lighting, the current being generated by an axle driven dynamo, the effort being to obtain a system of substantial construction, simplicity of device and reliability of operation. In addition to the dynamo the system includes a dynamo regulator installed in the car, a lamp regulator installed under the car and a storage battery of 32 cells in boxes under the car, as well as the necessary fixtures, switches, lamps, etc. The dynamo is a four pole, shunt wound machine, designed for 50 amperes at 80 volts. It is driven from the axle by two belts, one at either end, either belt being sufficient, however, to do the work. The dynamo is suspended from a steel shaft hung just outside the end piece of the truck, toward the center of the car. An adjustable spring belt tightener is provided to give the proper tension on the belts. The system operates normally on 60 volts, which pressure is maintained, with a small variation, by a very simple design of regulator. A lamp regulator for controlling the voltage on the lamps, so that any lamp will give the same illumination irrespective of the number turned on in the circuit, or whether the battery is being charged or not, is provided. All the different parts of this apparatus are illustrated and their construction and operation is clearly described in this catalog. Several pages are also given up to illustrating a wide variety of electric fixtures for car lighting. Designs are shown for all conceivable purposes in single lamps, groups or chandeliers.

NOTES

CINCINNATI ELECTRICAL TOOL COMPANY.—This company announces the opening of a western office and warehouse, for the sale of electric tools, at 18th and Rockland streets, Chicago, Ill. This office is under the management of Mr. Oscar B. Wodack.

WARNER & SWASEY CO.—This company, whose main office is at Cleveland, O., announces that it has opened a Chicago office in the Commercial National Bank Building, Adams and Clark streets, which will be under the management of Mr. E. B. Boye.

CUTLER HAMMER MFG. CO.—This company, which some months ago announced its purchase of the Wirt Electric Company of Philadelphia, advises that it has consolidated the Wirt business with that of its New York plant at Park avenue and 130th street, where the manufacture of Wirt apparatus will be continued.

AMERICAN LOCOMOTIVE COMPANY.—Among the orders recently received by this company are included 125 locomotives for the Harriman Lines, which order is made up of 30 mogul, 10 Atlantic type, 43 consolidation, 24 ten-wheel and 18 six-wheel switching engines. It has also received an order for a compound steam motor car for the C. R. I. & P. Railway.

EVENING CLASSES AT COLUMBIA UNIVERSITY.—During the year 1907-8 Columbia University offers twenty evening courses specially adapted to the needs of technical and professional workers. A full description of these courses is contained in the announcement of extension teaching, which may be obtained from the Director of Extension Teaching, addressed at the University.

STANDARD ROLLER BEARING COMPANY.—Mr. C. D. Sternfels, formerly manager of the publicity department of the Arthur Koppel Company, has been appointed manager of the publicity department of the above company, with headquarters at the home office in Philadelphia. The company has recently increased its capital from $3,500,000 to $5,000,000. Large additions are being made to its plant and equipment, and an entirely new department is being established for the manufacture of roller bearings for trolley cars. It is stated that about $300 per year per car is saved by the use of roller bearings.

PUBLICITY ENGINEER.—Mr. Walter B. Snow, who, for nearly twenty-five years, has been connected with the B. F. Sturtevant Company, announces that he is prepared to undertake work of any kind in the broad field of publicity for manufacturers of machinery and allied products. His regular service will cover the conduct of the publicity departments of a limited number of non-competitive plants and special service can be rendered to others in the form of general advertising, catalog making, technical writing and investigation. Mr. Snow has had a long and intimate acquaintance with engineering in general, and publicity in particular, and is specially well fitted to undertake this work. His office is at 170 Summer street, Boston, Mass.